Impact assessment of the investment:

VegNET – Bowen Gumlu & Far North Queensland (VG19008)

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Hort Innovation

Previous page image courtesy of VG19008 project reporting.

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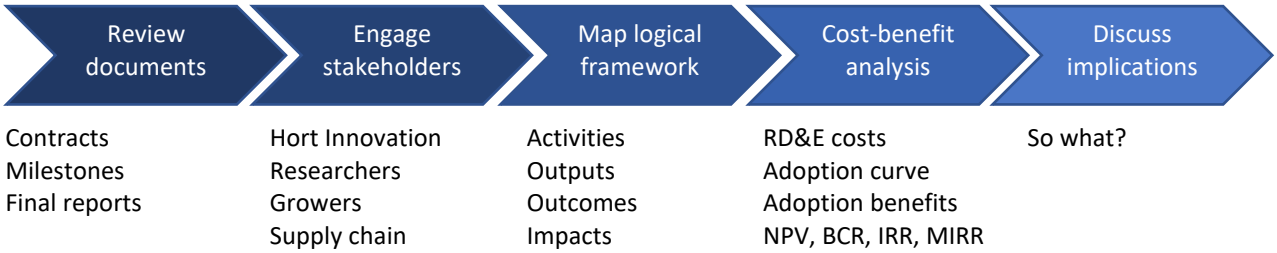
Executive summary

What the report is about

Ag Econ conducted independent analysis to determine the economic, social, and environmental impact resulting from delivery of the vegetable project *VG19008 VegNET – Bowen Gumlu & Far North Queensland*. The project was funded by Hort Innovation over the period May 2020 to September 2021 using the vegetable research and development levy and contributions from the Australian Government.

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



Research Background

Extension had long been a key driver of adoption of R&D outputs in the Australian vegetable industry. However, the industry had identified that the capacity of extension services had diminished over time, particularly at a regional level. As a result, the National Vegetable Extension Network (VegNET) commenced in 2016 as a program approach for increasing grower awareness and capacity for adopting new practices identified through levy-funded research and development projects. Project VG19008 was one of the 10 regional delivery branches under the VegNET umbrella, with a focus on the Bowen, Gumlu, Burdekin and Atherton Tableland growing regions.

Key Findings

The nominal investment cost of $0.6 million was adjusted for inflation (ABS, 2023) and discounted (using a 5% real discount rate) to a present value (PV) of costs equal to $0.9 million (2022-23 PV).

The VG19008 impact pathway was evaluated through a logical framework. As part of the national VegNET 2.0 program, VG19008 was a short-term project designed to provide continuity between the longer term VegNET 1.0 (2016-2020) and VegNET 3.0 (2021-2025). Key initiatives that were subject to extension included pest and disease management and biosecurity (particularly relating to Fall Armyworm), management practices to support the health of the Great Barrier Reef, and digital technology opportunities (including improved weather data). VegNET 2.0 introduced a *Systems Thinking* approach to the design and delivery of the vegetable industry extension strategy that continued into VegNET 3.0.

While several potential impacts were identified relating to industry development and capability support, economic impacts were not able to be confidently estimated. The context in which project VG19008 was delivered, focusing on facilitating the short-term continuation of VegNET in the Far North Queensland region while a longer term project was prepared meant that there was limited time for meaningful engagement with regional stakeholders. This was compounded by subsequent changes to regional priorities and Regional Development Officers (RDOs) following the conclusion of the project, limiting the long-term legacy in contributing to regional industry development. Stakeholders also highlighted that RDO staff changes had contributed to inadequate data collection relating to extension outcomes such as practice change.

The collection of evidence linking outcomes (changes in knowledge, skills, awareness, and actual or intended grower practice changes) to specific coordination and engagement actions would support a quantified measure of impact for VG19008 or similar investments. However, given the short nature of the project, it is unlikely that the marginal benefit with regards to the broader VegNET program would be sufficiently clear to attribute impact. Furthermore, to accurately quantify the impact of extension and communication program such as VegNET, the change in adoption resulting from the extension activities needs to be assessed for each individual R&D output or recommendation. Where extension programs such as VegNET are responsible for extending all industry R&D, this effectively means that all R&D should be considered in the analysis, which is clearly unrealistic. As such, it is recommended that impact assessments focus on individual R&D outputs or recommendations, with extension included as a supporting element.

The key findings of the VG19008 impact assessment are summarized in Figure 1 below.

Keywords

Impact assessment, cost-benefit analysis, vegetable, extension, industry development, Bowen Gumlu & Far North Queensland , Fall Armyworm, innovation systems

Figure 1. Summary of impact assessment findings

VG19008 Impact assessment summary

RD&E activities

Outcomes

Impacts

Total RD&E costs:

- $0.26 million (nominal value)
- 69% R&D levy and Government matching, and 21% BGGA in-kind.

Extension activities:

- Regional Extension Advisory Group Established
- 5 year regional extension priorities and annual plan developed.
- Grower engagements delivered through field days, seminars, workshops, webinars and direct outreach.
- 7 BGGA newsletters.
- Bowen Weather Station Network integration support.

Expected outcomes:

- Increased grower knowledge, attitudes, skills and aspirations (KASA) relating to regional priorities and response capacity.
- Improved regional extension prioritisation and R&D planning.

Industry adoption:

- Weather station hosts practicing improved irrigation scheduling and chemical application practices
- Grower practice development of improved methods for integrated management of Fall Armyworm (FAW)

Economic impacts:

- Reduced risk (FAW)
- Reduced chemical and irrigation input costs ($/ha) (with improved weather data).

Environmental impacts:

- Improved environmental outcomes from a greater awareness of regional ecosystem issues and adoption of best management practices.

Social impacts:

- Increased contribution to regional community wellbeing from more profitable and resilient vegetable growers.

Total Impact

- A quantitative impact assessment was not performed due to insufficient data to attribute a marginal benefit to VG19008 with regards to improved R&D outcomes such as increased adoption.

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, Ag Econ was commissioned to deliver the *Horticulture Impact Assessment Program 2020-21 to 2022-23* (MT21015).

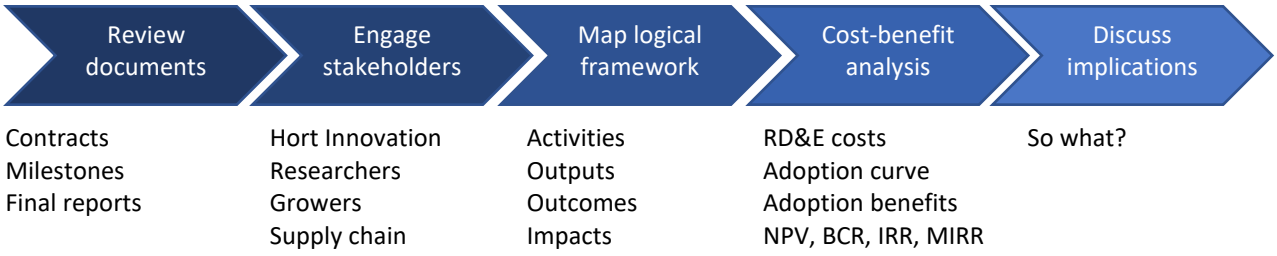
Project *VG19008 VegNET – Bowen Gumlu & Far North Queensland* was randomly selected as one of the 15 investments in the 2021-22 sample. This report presents the analysis and findings of the project impact assessment.

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 the 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's impact pathway, including activities, outputs, and 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 then sensitivity test the results to changes in 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 MT21015 project page Horticulture Impact Assessment Program 2020/21 to 2022/23 (MT21015).

Project background

Extension had long been a key driver of adoption of R&D information in the Australian vegetable industry. However, the industry had identified that extension services that had previously been run by the state Departments of Agriculture had been cut significantly. The gap had been filled to some extent by Industry Development Officers (IDOs) and regional grower organisations, but dwindling resources meant that these services had reduced over time. While research continued to produce a large volume of outputs, the changes and challenges in extension services meant that much of the valuable information outputs languished in final reports and in other publications and had not effectively reached Australian

vegetable growers. The need for vegetable R&D extension services in Australia was identified and addressed by the Vegetable Industry Strategic Investment Plan (SIP) 2012-2017. Targets included increasing the end-user satisfaction of each R&D project; increasing the percentage of levy funded projects that have grower end user participation; and to facilitate the development of the vegetable industry at the regional level.

As a result, the National Vegetable Extension Network (VegNET) commenced in 2016 as a program approach for increasing grower awareness and capacity for adopting new practices identified through levy-funded research and development projects. The VegNET program was initially delivered for a three year term across 10 vegetable levy-funded projects "VegNET 1.0" that aligned with the major vegetable production regions. In VegNET 1.0, regional extension delivery was supported by a dedicated Industry Development Officer (IDO) who had a general remit around the delivery of extension activities in the region. One of the regions of focus in VegNET 1.0 was Bowen Gumllu and Far North Queensland (through VG15004 and a one year extension with VG18003).

As part of its final outputs, VegNet 1.0 developed an Extension Strategy for the Australian Vegetable Industry. The Strategy identified that VegNET's regional extension delivery model would be strengthened by focusing on an *Innovation Systems* approach that utilises the experience and perspectives of stakeholders to understand the objectives, questions, challenges and opportunities of stakeholders in a region. The Innovation Systems approach shifts the role of extension from being a conduit of technical insight to an enabler or broker of knowledge. This approach was recommended given that stakeholder challenges were identified as generally being systems orientated and not amenable to a linear, technology transfer extension approach.

The Vegetable Extension Strategy also recommended the development of regional extension strategies which identify specific problem areas and required practice changes in priority areas, compared with a focus on general technology adoption. These strategies were to be supported by a Regional Extension Advisory Group (REAG) and led by a Regional Development Officer (RDO) (replacing the position of VegNET IDO). The delivery of grower extension over a continuous 5 year period was recommended.

By the time VegNet1.0 concluded in 2020, the vegetable industry had reenforced its focus on industry extension through the 2017-2021 Vegetable Strategic Investment Plan (particularly Outcome 5: *Improvements in industry capability*, Strategy 1: *Improve communication and extension of research outputs to address a geographically and culturally diverse vegetable industry)*

To support the continuity of extension delivery through the existing VegNET program model, while progressing the Strategy's recommendations, an 18 month iteration "VegNET2.0" was delivered while a longer term 5 year program could be planned and procured[1]. Through project VG19008 Bowen Gumlu and Far North Queensland continued as one of the 10 regional delivery branches with a focus on building industry capability of levy payers to adopt improved practices across the Bowen, Gumlu, Burdekin and Atherton Tableland growing regions. These regions have a combined production value of $568 million with major vegetable crops including capsicums, beans, sweetcorn, eggplant, chillies, cucurbits, pumpkins, melons sweetpotatoes and potatoes.

Project details

Bowen Gumlu Growers' Association Inc was selected as the lead delivery partner, with the project running from 2020 to 2021 (Table 1)

Table 1. Project details

Project code	VG19008
Title	VegNET – Bowen Gumlu and Far North Queensland
Research organization	Bowen Gumlu Growers' Association Inc (BGGA)
Project leader	Sarah Limpus
Funding period	May 2020 – September 2021
Objective	Increase the capacity of levy paying vegetable growers in North and Far North Queensland to adopt improved practices and new innovation.

[1] VegNET3.0 (VG21000) is the current 5 year iteration of the vegetable extension program which commenced in October 2021: https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/vg21000/

Logical framework

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

Table 2. Project logical framework detail

RD&E activities

The project funded a RDO for Bowen Gumlu and Far North Queensland, who was hosted by the Bowen Gumlu Growers' Association (BGGA) in Bowen. The RDO had started the role in November 2019 in the predecessor project VG18003. The RDO:

- Participated in national VegNET team activities.
- Established REAG and coordinated group meetings.
- In consultation with the 20 BGGA members and 40 non-member stakeholders, the RDO developed 5 year regional extension priorities and an annual plan for the extension of R&D focussing on three areas as below.
  - Biosecurity.
    - Engaged with the National Biosecurity Network Community to understand pest and disease awareness, management and approaches to encourage a regional community of practice.
    - Developed a communication and extension strategy for Queensland's Fall Armyworm (FAW) response in the Bowen, Gumlu and Burdekin region.
    - Engaged AUSVEG to develop trial site for the iMAP Pests project at Bowen.
    - General activities to improve biosecurity awareness and support in the regional and farming community through stakeholder engagement activities as below.
  - Productivity.
    - Promoted the use of the Bowen Weather Station Network, including through three Weather Station hosts, for monitoring micro-climates in the Bowen horticultural district, including 1 information session understanding hyperlocal weather station data to modify chemical pest control strategies, the development of protocols to support more accurate fruit ripening, chill damage and harvest timeframes, a weather station visit, and general engagement activities as below.
    - Reviewed and updated three gross margins for vegetable crops in collaboration with an economist.
    - General activities to improve understanding and skills relating to business analytical techniques, new crop options, integrated pest and disease management and area wide management, and new technologies.
  - Sustainability.
    - Co-developed a collaborative proposal for future funding in consultation with the Queensland Department of Agriculture and Fisheries (QDAF) for 'Great Barrier Reef Horticulture Agronomy for Water Quality'.
    - Supported development of 'Future Reef Program Design and Support in Horticulture'.
- Undertook a range of general stakeholder engagement activities including:
  - Contributed to 7 BGGA newsletters.
  - Contributed to 5 Vegetables Australia Magazines, VegNET column.
  - Contributed to 1 Brisbane Markets Fresh Source Magazine.
  - Delivered 2 x pest and diseases workshops in Ayr and Gumlu (57 attendees).
  - Contributed to 5 R&D Spotlight' emails to 80 growers on completed levy investments.
  - Presented at the 2021 Hort Connections Conference.
- Coordination and collaboration.
  - Engage with regional stakeholders including Growcom, Bundaberg Fruit and Vegetable Growers, QDAF, Hort Innovation to understand broader issues and collaboration opportunities.
  - Co-authored a case study on Controlled Traffic Farming and Precision Agriculture adoption.

RD&E outputs

- REAG for Northern Queensland region.
- Regional extension priorities and annual plans developed (Biosecurity, Productivity, Sustainability).
- General stakeholder engagement activities/outputs as above.

Outcomes

- Stakeholders have increased knowledge, attitudes, skills and aspirations (KASA) relating to industry innovation and research outputs to address regional specific issues including improved pest and disease management (such as the use of localised weather data), biosecurity (including for FAW), soil and ecosystem health, and agtech options.
- Stakeholders have greater confidence to make practice changes in line with new R&D or innovations. The final report stated practice changes as a result of VG19008 were:
  - Weather station hosts demonstrated the potential to:
    - Modify irrigation scheduling based on weather station data including rainfall, humidity, temperature, and evaporation.
    - Change practices for chemical application timings and effectiveness using temperature, humidity, and Delta-T generated by weather stations.
    - Use weather station data to develop calculations for growing degree days and heat and chill thresholds for crops to assist with management intervention decisions.
  - Growers demonstrated improved methods for integrated management of FAW, including alterations to chemical application strategies to improve efficacy; encouraging and releasing beneficial predators and parasitoids of FAW; and increased pest surveillance to allow earlier intervention and control.
- Regional development staff, vegetable growers, advisors and the supply chain have additional skills in liaison, extension, innovation, and production, supporting broader industry outcomes including improved extension prioritisation and R&D planning.
- Increased RDO capability to deliver best practice extension, supporting grower engagement and practice change across targeted regional priorities.

Impacts

- By supporting higher or earlier adoption of industry innovation and best practices than would otherwise have occurred across the key focus areas (biosecurity, productivity, sustainability), VG19008 had the potential to support the following impacts.
  - Biosecurity.
    - [Economic] Reduced risk faced by key pests such as FAW, through improved awareness, surveillance and understanding of management options (such as variations in chemical and biological control methods).
    - [Environmental] Reduced environmental impacts from improved surveillance and early intervention, as well as the integration of biological controls with reduced reliance on chemical management approaches.
  - Productivity.
    - [Economic] Reduced average cost of chemical applications ($/ha) from improved application efficiency.
    - [Environmental] Reduced off target chemical impacts from improved application efficiency.
    - [Economic] Improved water productivity ($/ML) from improved irrigation scheduling.
  - Sustainability.
    - [Environmental] Improved environmental outcomes from increased awareness of regional ecosystem issues and adoption of associated farming best practices.
  - Other impact areas.
    - [Social] Increased contribution to regional community wellbeing and resilience from more profitable and sustainable vegetable growers.

Project costs

The project was funded by Hort Innovation, using the vegetable research and development levy and contributions from the Australian Government, with additional funding from the regional extension partner BGGA (Table 3). 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 ($)	Hort Innovation overheads[1] ($)	BGGA In-Kind[2]	Total nominal ($)
2020	57,931	10,070	30,370	98,371
2021	115,862	17,346	60,740	193,949
2022	-21,443[3]	1,219[3]	-11,241	-31,466
Total	**152,350**	**28,635**	**79,869**	**260,854**

1. The overhead and administrative costs were calculated from the Statement of Comprehensive Income in the Hort Innovation Vegetable Fund Annual Reports from 2019-20, 2020-21 and 2021-22 averaging 15.8% for the VG19008 funding period.
2. Other funds from BGGA are provided in the contract as a lump sum, so have been apportioned yearly based on Hort Innovation cash costs.
3. In 2021-22 a final milestone of $8,135.90 was paid, while at the same time $29,579 in unspent funds were returned to Hort Innovation, resulting in a net cost of -$21,443. The Hort Innovation overhead costs of $1219 were calculated on the final milestone payment of $8135.9.

Present Value of investment

The nominal total investment cost of $0.26 million identified in Table 3 was adjusted for inflation (ABS, 2023) into a real investment of $0.30 million (2022-23 equivalent values). This was then further adjusted to reflect the time value of money using a real discount rate of 5% (CRRDC 2018), generating a present value (PV) of costs equal to $0.34 million (2022-23 PV).

Project impacts

Potential impacts identified in Table 2 were evaluated against available data to determine if their impact could be quantified with a suitable level of confidence. Overall, a review of available data and discussions with stakeholders highlighted a lack of data relating to extension outcomes (changes in awareness, knowledge, skills), or subsequent practice change or the extent of economic, social or environmental effects resulting from practice change. This was compounded by the short duration of the project and change in staff and priorities following the projects conclusion. As a result, none of the potential impacts identified through the logical framework process were able to be valued. Investigations into some of the potential impact areas are discussed in more detail below.

Biosecurity. FAW response support

FAW established in key North Queensland regions during the first half of 2020 primarily in sweetcorn and capsicum. Several initiatives were delivered by the project during this establishment period to support a more coordinated response and information exchange between growers, state jurisdictions and researchers regarding the FAW incursion. A communication and extension strategy guiding the regional response was prepared and was identified as having the potential to engage industry with best practices for FAW management. The final report indicated practice change relating to pest surveillance and management as a result of VG19008; however, no data was provided to validate this, and discussions with stakeholders highlighted that available information on FAW management was (and still is) emerging and not yet sufficiently developed to guide practice change, with key guidance at the time of the project focussing on pest identification. Several levy funded RD&E investments have since been procured to support a dedicated FAW management response, including: *Field-based testing for fall armyworm* (MT19014); *Identifying potential parasitoids of the fall armyworm, Spodoptera frugiperda, and the risk to Australian horticulture* (MT19015); and *Co-developing and extending integrated Spodoptera frugiperda (fall armyworm) management systems for the Australian vegetable industry* (VG20003). As such, while the early coordination capability provided through VG19008 supported the identification of these research and knowledge gaps, the extent to which the successes of these ongoing investments can be attributed to the VG19008 remains uncertain at this time. Further, as the development of FAW management strategies is still ongoing through these research projects, it was not possible to quantify potential economic impacts regarding avoided losses from FAW.

Productivity. Use of the Bowen Weather Station Network

While up to three locally based growers were believed to be regularly utilising data from the weather station to inform their growing practices as a result of VG19008, no grower details were available from project stakeholders to validate the ongoing use of the weather data or the extent of impacts experienced. Stakeholders involved in the current iteration "VegNET3.0"

(VG21000) were also unable to provide detail on the specific growers involved or estimate the extent of impacts experienced as this was no longer a regional priority and was not actively extended to growers. As a result, while project VG19008 did engage a small cohort of growers to utilise more accurate weather data to inform production management decisions, data gaps relating to the specific magnitude of practice change (compounded by staff changes and the discontinuation of weather station grower engagement as an extension priority) limited the ability to provide meaningful quantification of the economic impacts generated.

Other impact areas

Several social and environmental impacts were also identified through the logical framework, including environmental outcomes from improved farm irrigation and pest management practices, as well as improved local community resilience from more profitable and sustainable horticultural businesses. The analysis was unable to quantify these spillover social and environmental impacts due to the lack of data to attribute adoption or ground level outcomes to VG19008. such as social and community benefits arising from improvements in the overall grower capacity to implement best management practices, and environmental benefits from improved pest management practices and awareness of best practice for regional ecosystem health.

Project stakeholders commented that the delivery of extension remains crucial to supporting the overall development of industry. It was noted that the VegNET2.0 program's short delivery timeframe, combined with changes to regional priorities and RDOs following the conclusion of the project, limited the long-term legacy in contributing to regional industry development. Stakeholders commented that a longer term (5 year investment horizon) approach to delivering regional extension is a crucial component of supporting future impact, given that the pathway to RDOs influencing grower practice change was built on relationships and trust, which takes time to develop. Despite the challenges in sustaining extension practitioners over the long term and in sustaining robust regional priorities, VG19008 was still viewed as being an important precursor to future extension program successes, underpinned by the *Systems Thinking* approach and focus on supporting the development of a regional strategy – features which have continued into the current VegNET iteration.

Implications and learnings

The delivery of VG19008 sought to increase the overall capacity of Bowen Gumlu & Far North Queensland vegetable growers to adopt industry innovation and best practice through the delivery of targeted and regionally focused extension initiatives. As part of the national VegNET 2.0 program, VG19008 was a short term project designed to provide continuity between the longer term VegNET 1.0 (2016-2020) and VegNET 3.0 (2021-2025). Key initiatives that were subject to extension included management practices supporting health of the Great Barrier Reef, and digital technology. VegNET 2.0 introduced a *Systems Thinking* approach to the design and delivery of the vegetable industry extension strategy. This approach was informed through the National Vegetable Extension Strategy and provided an important development in building the overall capability and focus of extension delivery which continues through VegNET 3.0.

While several potential impact areas were identified relating to industry development and capability support, economic impacts were not able to be confidently estimated for several reasons. The context in which project VG19008 was delivered, focusing on facilitating the short-term continuation of VegNET in the Far North Queensland region while a longer term project was prepared limited the time for meaningful engagement with regional stakeholders. This was compounded by subsequent changes to regional priorities and RDOs following the conclusion of the project, limiting the long-term legacy in contributing to regional industry development.

Stakeholders commented that while extension is important in building industry capacity and development, the extent to which these programs support practice change is closely related to the level of trust that is developed with project leads and RDOs. = Extension projects with a short term delivery period (such as VG19008) were considered constrained in their ability to achieve this trust. This in conjunction with delivery staff turnover were highlighted by stakeholders as material reasons why the direct linkage and measurement of practice change was not possible. This serves to highlight the importance of consistent and long term extension program delivery that can establish goodwill and trust over time with growers in support of building capability and driving practice change.

Stakeholders also highlighted that frequent changes in RDO staff had underpinned inadequate data collection relating to extension outcomes such as practice change. For example, grower engagement around the benefits of leveraging data from the Bowen Weather Station Network was identified as being a potentially strong example of extension directly supporting practice change; however, stakeholders consulted were not able to identify growers who were potentially affected or the extent of any benefits of adoption, indicating the difficulty in attributing impact to this initiative. . Similarly, while VG19008 supported the identification of research and knowledge gaps for FAW following its appearance in early 2020, the outcomes

and impacts of this ongoing research is unknown, and the extent to which any successes of these investments could be attributed to the VG19008 is uncertain. Once the implications of this research are known, any future impact assessment of the FAW response could consider this early contribution of VG19008.

This stakeholder feedback supported the logical framework of the impact assessment that highlighted the importance of collecting evidence of outcomes (changes in knowledge, skills, awareness, and actual or intended grower practice changes) that can be linked to specific coordination and engagement activities to demonstrate investment success. At the same time, however, the short nature of VG19008 made it unlikely that the marginal benefit of VG19008 with regards to the broader VegNET program would be sufficiently clear to attribute a quantifiable impact to VG19008 alone. Furthermore, to accurately quantify the impact of extension programs such as VegNET, the change in adoption resulting from the extension activities needs to be assessed for each individual R&D output or recommendation. Where extension programs such as VegNET are responsible for extending all industry R&D, this effectively means that all R&D should be considered in the analysis, which is a significant undertaking clearly outside of the MT21015 remit. As such, it is recommended (as previously in the MT2015 year 1 Summary Report (Ag Econ 2022)) that impact assessments focus on individual R&D outputs or recommendations, with "enabler" activities such as extension, communication, and coordination included considered as part of the total investment cost.

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 theme						
Stakeholder and organisation	**Stakeholder type**	**Related research**	**Research inputs**	**Research outputs**	**Research immediate outcomes**	**Follow on research**	**Stakeholder adoption**	**Impact areas and data**
Olive Hood, Hort Innovation	Funding organisation	✓	✓	✓	✓	✓		✓
David Shorten, Bowen Gumlu Growers Association	Research organisation	✓	✓	✓	✓	✓	✓	✓
Sarah Limpus, Queensland Department of Agriculture and Fisheries	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	The process of relating the costs and benefits of an investment to a base year 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 to make them comparable across time.
Spillover Effects	Impacts generated for stakeholders who did not fund the RD&E, including other agricultural industries, consumers, communities, and the environment.

Abbreviations

BGGA Bowen Gumlu Growers' Association

CRRDC Council of Rural Research and Development Corporations

IDO Industry Development Officer

RD&E Research, Development and Extension

RDO Regional Development Officer

REAG Regional Extension Advisory Group

SIP Strategic Investment Plan

VegNET The national vegetable industry extension program funded through the vegetable industry R&D levy

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