Informing Queensland Horticulture's Knowledge & Farm Business Plans.

The Project team researched and developed 4 Critical Temperature Threshold documents, produced six bi-monthly Long Lead Time (1,2,3 month) forecasts for collaborating business managers in both the Lockyer Valley and Granite Belt, and held start and end of season face to face industry update and engagement workshops.

Project Team *July 2024- June 2025,*
David Carey, Senior Horticulturist, DPI Qld & **Peter Deuter**, Horticultural Consultant, PLD Horticulture

Executive Summary.

The Project Team has researched, developed, promoted and delivered 4 Critical Temperature Threshold (CCT) crop documents. Each CCT analysis document details the physiological temperature thresholds of the crop at its various growth and development stages. This comprehensive assessment also examines and analyses the current and historic temperatures at all major crop production locations in Queensland, as well as assessing all major interstate (competitive) growing locations. Current and historic temperature data is accessed and analysed using DPI's Climate Monitor Webtool, developed by the Project Team during a previous DCAP project.
The impact of Projected future temperatures (2050's), sourced from the publicly available My Climate View web-portal for each crop (based on the crop's physiological temperature thresholds and each location) is then examined, analysed, assessed and reported. This science-based assessment provides Queensland horticultural business managers and supply chain managers with an objective analysis of location specific projected temperatures and their impacts, informing and guiding future business and farm planning.

The Project work focussed on Horticultural crops important to Queenslands economy, that underpin and drive both the entire state and each regions prosperity, workforce and economy. Critical Temperature Threshold crop analysis documents have been completed for **banana**, **avocado**, **mango** and **sweetpotato** and will be publicly available to Queensland's horticultural Business and Supply Chain managers via the Queensland Governments Long Paddock website. They join the previous 13 CTT crop documents, already available from a previous project, funded by DCAP. Each comprehensive CTT crop document (40 – 50 pages) analyses, graphs, examines and explores the impact of projected future temperatures on both crop seasonality and productivity at each production location. Designed to inform Queensland business managers, each document uses high quality science, research and industry knowledge to compare and contrast recent "lived" growing temperatures and seasons Projected to 2050's temperature conditions.
The Project team also developed and delivered 6 x bi-monthly Long Lead Time Forecasts (1,2 & 3 month lead-time for Max and Min temperature, and Rainfall) for the Granite Belt and Lockyer Valley horticultural production regions and provided winter season forecasts for the Bowen Region. Forecasts for 12 months X 3 monthly weather elements (Min, Max and Rain) X 2 locations (Lockyer Valley and Granite Belt), plus 6 months of forecasts for the Bowen horticultural growing region. The accuracy of each forecast element and month was assessed statistically and these results were shared with our collaborators (farm business and supply chain managers).

Most importantly, collaborating farm business managers and national supply chain managers have continued to engage with, support and learn from this FBRP funded Horticulture industry project. Anonymous electronic survey results gained from collaborator input during Project Staff presentations and

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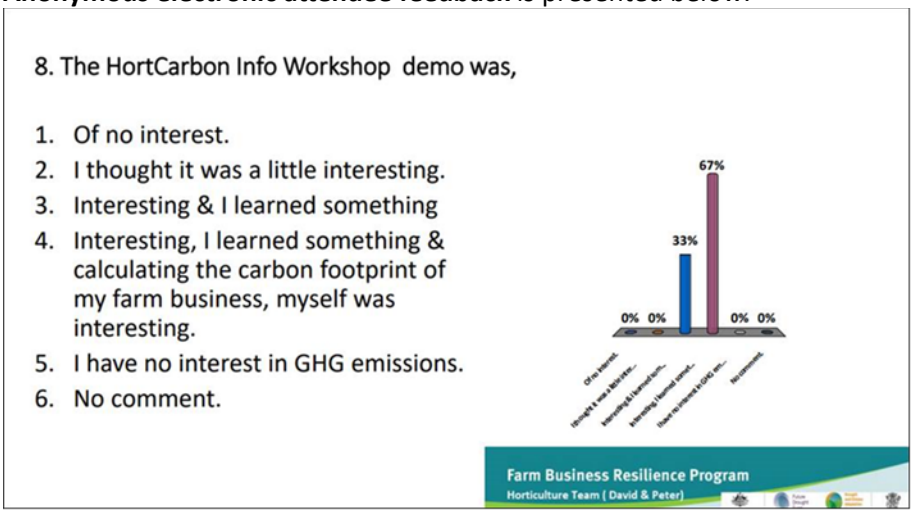
discussions during the start and end of season face to face interactive workshop sessions, amplify and identify this industry, interest, benefit and support.

The Project Team organised and ran a separate additional HortCarbon Info "Hands on calculate your farm and business emissions workshop" in early June 2025. This practical, "calculate your own businesses emissions" session allowed, explained and assisted Granite Belt agricultural businesses, to use their own farm data to accurately calculate their own emissions.

This 2-hour interactive practical hands-on session, enhanced local business managers knowledge of carbon emissions, allowing them to learn about and use DCAP's HortCarbon Info web-tool at their own pace, with guidance, assistance and explanation from Peter Deuter and David Carey. Attendees calculated their own business emissions and discussed how their emissions compared with other growers, businesses and with other agricultural sectors (grazing, cropping, dairy etc).

The June 2025 HortCarbon Info "Hands on Industry Workshop" was organised after a request from the SQNNSW Innovation Hub in conjunction with the Granite Belt Growers Association. The 2 Hr interactive Workshop session attended by around 11 interested local participants including a large local farm business that also runs a vegetable pack-house that packs for other growers. The session was tailored to industry requests and provided an overview of how, and why businesses may need to use, HortCarbon Info. FBRP project staff actively assisted the attendees to carry out an analysis of their farm business emissions, using their business data on their own computer. Active learning, to build knowledge and skills.

Anonymous electronic attendee feedback is presented below.



Project Background.

All horticultural crops are temperature sensitive, and most have specific temperature requirements for optimum yield and quality. Understanding the specific impact of temperature increases on a horticultural commodities, seasonality, quality and yield is a critical step in providing growers with the decision-making tools to enhance and inform both their current and future farm and business plans.

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This projects' focus was on temperature thresholds, to the exclusion of rainfall effects, because most horticulture crops in Australia are irrigated. While this approach did not discount the importance of rainfall and associated runoff into irrigation storages, it is temperature which largely determines the location, performance and viability of most horticultural commodities in Australia.

Over the past decade vegetable growers around Australia, and especially in the Granite Belt and Lockyer Valley have experienced unprecedented temperature conditions which have negatively impacted crop yield, quality and production, including increased frequency and intensity of heat waves. An improved science-based understanding of the critical temperature thresholds of a range of horticultural crops important to Queensland businesses and the state economy has become necessary, especially as the climate continues to change. Improved knowledge, understanding and awareness will inform and enhance improved management and business plans. Horticultural crops and businesses are characterised by, "high costs and high inputs", and Australian consumers demand and are accustomed to a constant supply of high quality fruit and vegetables.

High quality information, knowledge and awareness is increasingly required by astute business managers, as critical temperature thresholds are met, or exceeded more often and more regularly, for many horticultural crops and production locations.

In addition to researching, developing and delivering 4 comprehensive CTT Crop documents with FBRP funding, the Project Team (2024-25) also continued to develop and deliver bi-monthly Long Lead Time (1, 2 & 3 month) forecasts for the Lockyer Valley and Granite Belt region. The Lockyer Valley (LV) and Granite Belt (GB) Long Lead-Time forecasts cover a 3 month period, with 1, 2, and 3 month lead-time forecasts (Max, Min and Rainfall) issued every 2 months. This ensures business managers have a 3 month outlook, which is updated every 2 months. This procedure is carried out to ensure that with each bi-monthly forecast the previous 3rd month forecast is updated (after 2 months) to maximise grower guidance and enhance planning for the coming 2 months, while providing a longer 3 month rolling forecast of maximum and minimum temperatures and rainfall. The accuracy of every forecast is assessed and documented each month, and this information is regularly presented to, and discussed with, collaborating Farm and Supply Chain business managers.

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Project Methodology.

Critical Temperature Thresholds for important Qld crops,
Avocado, Banana, Mango and Sweetpotato.

1. Peer reviewed world-wide plant physiology research was used to determine the selected crops' Critical Temperature Thresholds, at each important growth stage.
2. This information was ground-truthed with industry and against known Queensland production locations and seasons.
3. This data was then combined to develop a detailed, unique crop CTT document that investigates the impact of projected 2050's temperatures on the yield and quality of the crops at important Queensland and Australian production locations**.**

Face to Face local meetings and discussions with major growers allowed the project team to obtain feedback on the CTT analysis documents to make them user friendly, accessible and easily understood by decision makers. The Horticulture project team actively engaged and interacted with both Queensland fruit and vegetable growers and supply chain business managers (e.g. Perfection Fresh/One Harvest/Lite & Easy). The CTT documents have been informed and finessed, thanks to industry feedback.

In addition to the 4 CTT Crop analysis documents, project staff continued to develop and distribute Long Lead Time 1-, 2- and 3-month forecasts for the Lockyer Valley, Granite Belt and interested Bowen (winter season) vegetable growers. Numerous Heatwave Advisories were also issued to collaborating business managers.

Significant extra work was completed in each CTT crop analysis documents – so that each Queensland focussed crop document also included and analysed projected temperature impacts (2050) at all major interstate production locations - e.g. Katherine, Sydney Basin, Manjimup. This extra work, analysis and detail, extends the reach of this Queensland funded work, making the CTT crop documents and information available, informative and relevant to not only Queensland but also National Horticultural business and supply chain managers.

In February 2025 the Project Team updated HortCarbon Info with the **latest August 2024 National Greenhouse Emissions Factors** to reflect recent small changes in the National Greenhouse Gas Accounts, **ensuring HortCarbon Info** remains **highly accurate**, relevant and up to date.

Long Lead Time Forecasts Component.
The Project Team has, "ground-truthed" all 90 (1, -2 -& 3 month) Long Lead Time forecasts that have been issued for both the Lockyer Valley and Granite Belt forecast regions since this production region focussed forecasting work began in 2018. This accuracy assessment was achieved by comparing each forecast with the actual BoM data (rainfall, minimum and maximum temperature) in each month in both the Lockyer Valley and Granite Belt regions. This analysis of accuracy was regularly presented to, and discussed with, collaborating business managers, as part of each "face to face" local forecast Workshop.

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During the recent June 2025 local business manager update sessions, the accuracy of each of the 90 monthly forecasts (90 for Gatton, 90 for Stanthorpe), for rainfall, minimum temperature and maximum temperature was presented and discussed. Throughout the project every bi-monthly forecast document also assessed the accuracy of the maximum and minimum temperature that was forecast for the preceding month. This ongoing accuracy analysis allowed collaborating business managers to, "double check" their own perceptions of forecast accuracy and develop an informed opinion, based on solid on-going data.

The overall accuracy of each forecast parameter and lead time for both the Lockyer Valley and Granite Belt at the time of this report is summarised below. An additional stand-alone Long Lead Time Final Report (2025) contains full details and results of this work program.

Project Results and Conclusions.

1.1 **Achievements and Outcomes** (against planned objectives and outputs)

- **Research, develop and document 4 critical temperature thresholds crop documents for, avocado, banana, mango and sweetpotato, all important Queensland horticultural crops.**

This high quality unique temperature and crop information enhances Queensland farm business mangers knowledge and will inform their current and future business and cropping plans**.** In addition, significant extra Nationally important production location information was developed and included. This allows Queensland business managers to see how and if projected (2050's) temperatures will change the growing conditions and seasonality of their major interstate competitors.

- **Utilising the data analysis power of Climate Monitor to identify and analyse ideal target crop production periods for SE Qld.**

The unique DCAP funded Climate Monitor web tool (freely available to the public on Long Paddock), was essential to this work and was used to analyse, interpret and graph, current and historical temperature data for all crops and locations (both in Qld and nationally), for each individual CTT document. Farm business and Supply Chain managers found the Climate Monitor CTT graphs and explanatory information easy to understand and user friendly**.**

- **Identifying adaptation strategies to enhance the resilience of vegetable industry businesses.**

Each of the 4-crop specific CTT document highlights and analyses, current and historic temperature regimes and associated growing seasons, at significant crop production locations. Using 2050 future temperature projections each document then outlines how future temperatures at each location are projected to change by 2050. This easy to interpret graphical information, and the accompanying commentary, allow business managers to "peek" into their future, and compare projected 2050 temperatures with those they have experienced in their living (and growing) memory. This proved to be a powerful technique, as business managers remembered past "hot" production years and periods and could compare those actual temperatures to projected 2050 temperatures. Past "lived experience" gave insight into potential adaption strategies and management techniques.

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- **Documenting management decisions which can be significantly improved with the application of advanced knowledge of climate variability and climate change impacts.**

Past and current crop growing experience, temperatures and resultant crop quality and marketable yields, allowed farm business and supply chain managers to, "contemplate and think about" what management and business decisions they could/would take, after reviewing their crop and production locations CTT analysis document. Each CTT crop document highlights and compares past "lived" temperatures, and using easily interpreted graphs compares them to projected 2050's temperatures.
Business managers in the Lockyer Valley, already challenged by warmer spring temperatures, had confirmed for them, that their season for some crops would be shortened. In the high-altitude Granite Belt, projected mean monthly maximum summer temperatures remain within most crops' upper CTT, and warming winter minimums could see an extension of the growing season for cold sensitive crops like capsicum and tomato. Apple production will be impacted as annual "chill hours" accumulation declines, a move to new lower chill varieties is one management strategy.

- **Engaging with growers and supply chain participants in a two-way dialogue to achieve and ground truth and communicate project objectives.**

Effective industry engagement was achieved during Face to face, interactive start and end of season workshops (2 – 3 hours). These practical, information focussed, local update workshops were well supported by business and supply chain mangers in both the Lockyer Valley and Granite Belt horticultural production regions.

In the Granite Belt, vegetable, apple and strawberry farm owner/managers engaged with this work and were included in all Project communication, receiving bi-monthly Long Lead Time forecasts and providing feedback at meetings, and during one on one farm visits.

The Lockyer Valley is dominated by vegetable production businesses, with a number being nationally important Chain Store contract suppliers who operate in multiple locations within Qld and interstate. These business managers embraced the Long Lead Time forecast information, supporting and attending local face to face workshops.

The Long Lead Time forecast work continued to be well supported and used by Farm and Supply Chain Business Managers. The 3-month lead time forecasts inform monthly planning cycles, while DCAP Heatwave Advisories (based on and promoting the BoM Heatwave service) allow Business Managers to plan for, and minimise, Heatwave impacts.

During the 12 month FBRP funding period an additional 6 location specific, bi-monthly Long Lead Time forecasts were developed for, and shared with, Lockyer Valley and Granite Belt business managers. Project staff also developed and shared 3 specific Bowen region Long Lead-Time forecasts with interested Bowen horticultural producers, who only produce during late autumn and winter.

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- **Current forecast accuracy assessment – summary.**

Maximum temperature forecasting was the initial focus of this (temperature focussed) work, however minimum and rainfall forecasts were also developed and continued, as requested by our collaborating business managers.

Lockyer Valley July 2018 – June 2025.

A total of 90 Monthly Long Lead Time temperature forecasts have been sent to you since July 2018.

Maximum

The one month lead (1 month ahead) has been **correct 70% of the time** and very close for 22%.
The two month lead (2 months ahead) has been **correct 68% of the time** and very close for 21%.
The three month lead (3 months ahead) has been **correct 71% of the time** and very close for 22%.

Minimum

The one month lead (1 month ahead) has been correct 49% of the time and very close for 26%.
The two month lead (2 months ahead) has been correct 49% of the time and very close for 25%.
The three month lead (3 months ahead) has been correct 51% of the time *and very close for 28%.*

Rainfall

The one month lead (1 month ahead) has been correct 60% of the time and very close for 20%.
The two month lead (2 months ahead) has been correct 51% of the time and very close for 26%.
The three month lead (3 months ahead) has been correct 56% of the time *and very close for 17%.*

A total of 90 Monthly 1,2, & 3 Month forecasts is a small number of forecasts to analyse for accurate trends; however, the **Maximum temperature forecast at all lead times has proved *useful*.**

Forecast accuracy assessments are based on rigorous statistical analysis to ensure forecast accuracy analysis is consistent.

Granite Belt July 2018 – June 2025.

Maximum

***The one month lead** (1 month ahead) has been **correct 63% of the time** and very close for 24%.*
The two month lead (2 months ahead) has been correct60% of the time and very close for 26%.
The three month lead (3 months ahead) has been correct 56% of the time *and very close for 30%.*

Minimum

The one month lead (1 month ahead) has been correct 56% of the time and very close for 28%.
The two month lead (2 months ahead) has been correct 57% of the time and very close for 25%.
The three month lead (3 months ahead) has been correct 55% of the time and very close for 29%.

Rainfall

The one month lead (1 month ahead) has been correct 63% of the time and very close for17%.
The two month lead (2 months ahead) has been correct 59% of the time and very close for 19%.
The three month lead (3 months ahead) has been correct 53% of the time and very close for *28%.*

A total of 90 Monthly 1,2, & 3 Month forecasts for each location is a small number of forecasts to analyse for accurate trends, however the **Maximum temperature forecast at the 1-month lead time** has proved **slightly *useful*** *in the Granite Belt*.

Forecast accuracy assessments are based on rigorous statistical analysis to ensure forecast accuracy analysis is consistent.

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- **Critical Temperature Thresholds – well received and embraced by industry**.

Project staff have been pleasantly surprised and buoyed by the positive discussions, feedback and comments received when explaining and highlighting the Critical Temperature Thresholds crop documents. Collaborating business managers reviewed and discussed these crop and location specific documents, many indicating that such information would inform and guide their future business/production plans.

Additional work – requested by Industry.

- **HortCarbon Info, "calculate your own farms emissions" workshop was conducted in Stanthorpe in response to industry requests.**

In early June 2025 HortCarbon Info "Hands on Industry Workshop" was organised after a request from the SQNNSW Innovation Hub, in conjunction with the Granite Belt Growers Association. The 2 Hr interactive Workshop session, attended by around 11 interested local participants – including a large farm business that also runs a vegetable pack-house. Participants used HortCarbon info to calculate their own business emissions.

What did collaborating business and farm managers think of the 12 months of project work*?*

Project feedback and anonymous workshop attendee surveys give an indication of collaborating Business and Supply Chain Manager views on the relevance, and perceived value, of this Horticulture project.

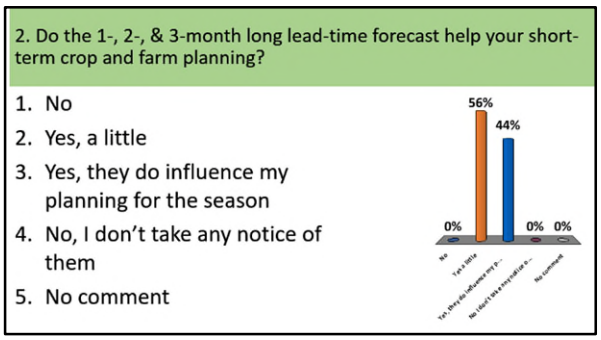
Farm and supply chain business managers have actively engaged with the project team throughout this 12 month project. See anonymous electronic opinions and feedback below.

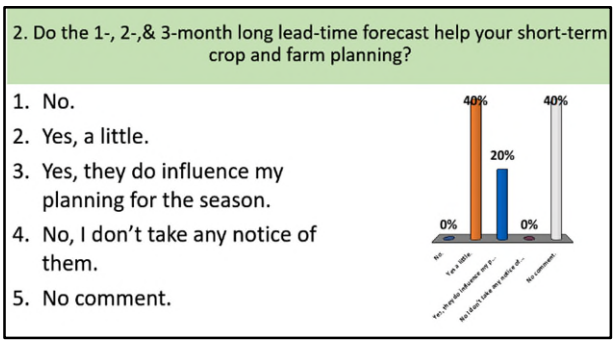
The electronic anonymous in-workshop feedback graphics below, from face to face industry, start and end of season update sessions in both the Granite Belt (Stanthorpe) and the Lockyer Valley (Gatton) over the last 12 months, convey the thoughts and opinions of our collaborating business managers

Informing Queensland Horticulture's Knowledge & Farm Business Plans - business manager feedback.

<u>Long Lead Time 1,2- & 3-Month forecasts</u>.

Do the Long Lead Time forecasts assist in business planning?





Lockyer Valley collaborating business managers (left) and Granite Belt business managers (right), anonymous feedback after the recent June 2025 local face to face workshops.

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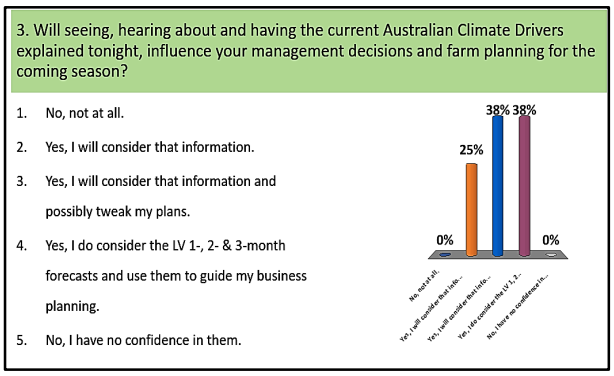
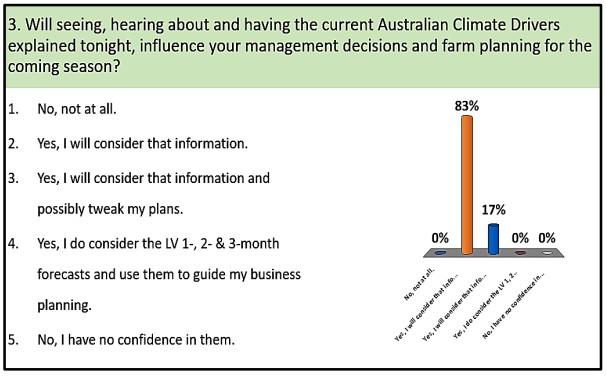
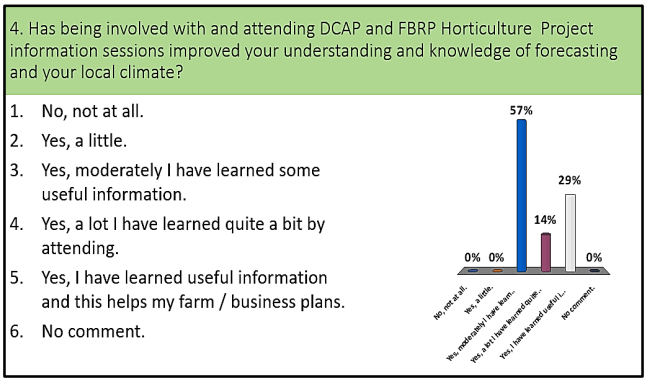
Current Australian Climate Drivers.
Does having current climate drivers explained inform business planning?

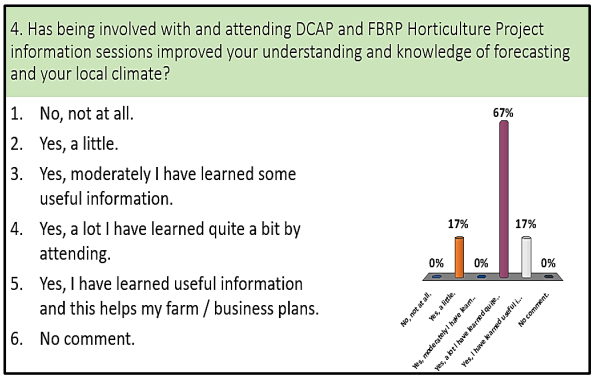




Lockyer Valley collaborating business managers (left) and Granite Belt business managers (right), anonymous opinion after the recent June 2025 local face to face workshops.

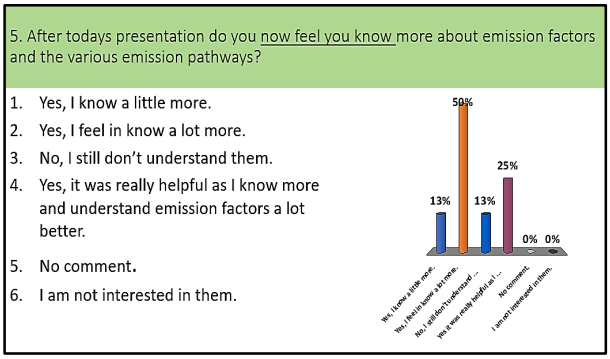
Have business managers gained new knowledge and skills to assist their business planning?
Local weather forecasts.

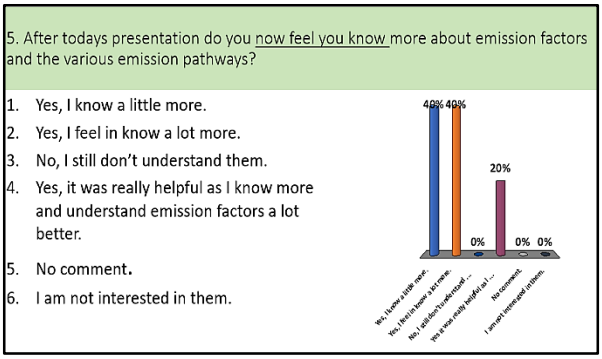




Lockyer Valley business managers opinion (left) Granite Belt-Stanthorpe (right) June 2025 workshops.

Have business managers gained new knowledge and skills to assist their business plans?
Greenhouse Gas Emissions factors used in Projected 2050's temperatures.





Lockyer Valley business managers opinion (left) Granite Belt-Stanthorpe (right) June 2025 workshops.

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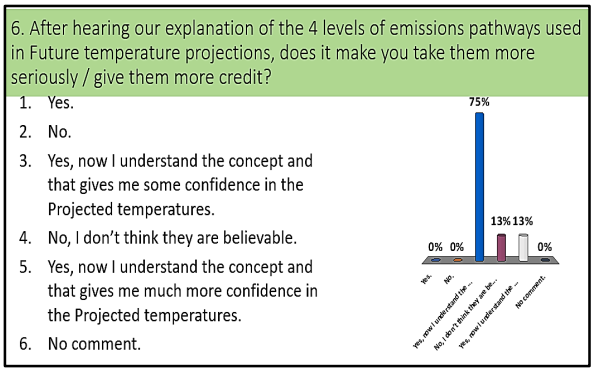
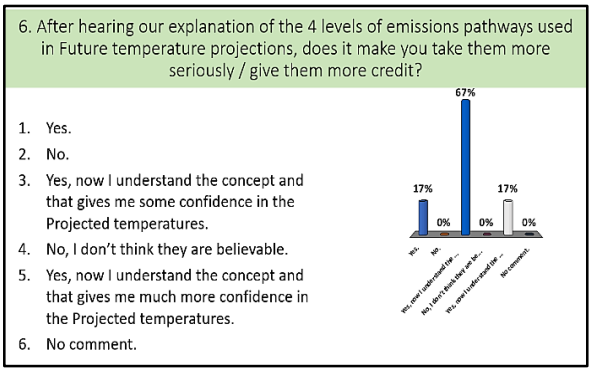
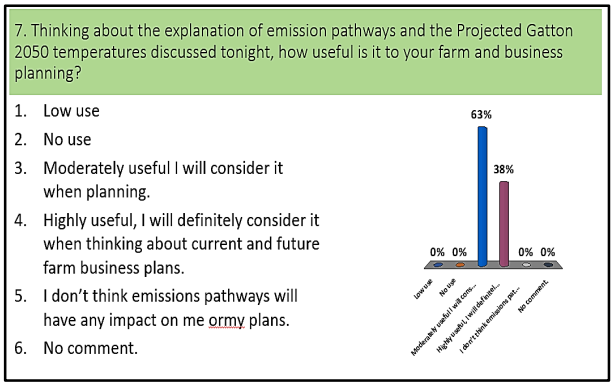
Have business managers gained new knowledge, understanding and skills to assist their current and future business plans?

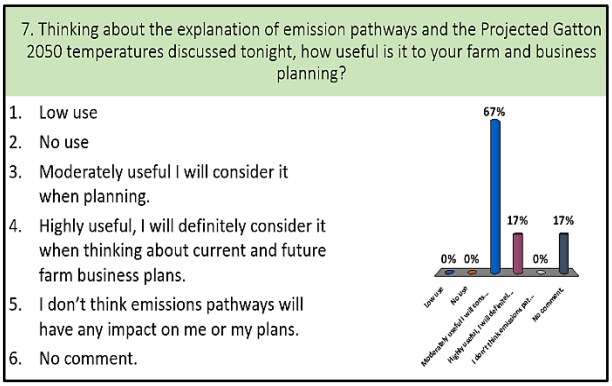




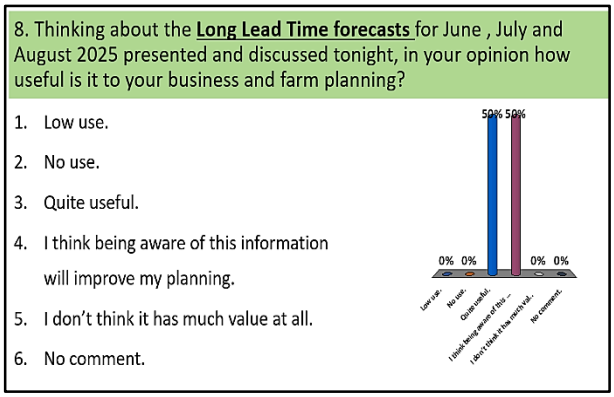
A greater understanding and recognition of the GHG emissions pathways used in the 2050's temperature projections was reported by both Lockyer Valley (left) and Granite Belt (right) business managers during the June 2025 workshops.

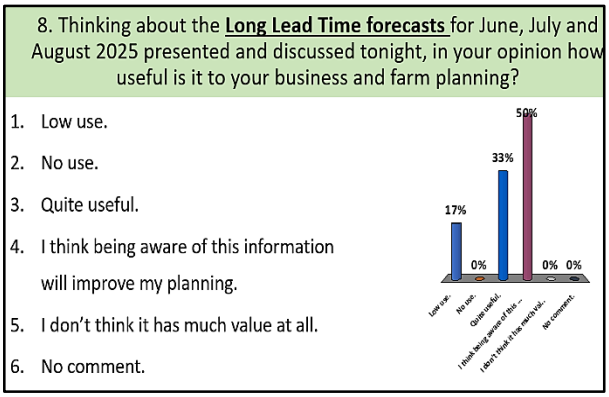
Will the FBRP horticulture project information assist and influence business plans?
Successful information transfer has occurred.





Both the Lockyer Valley (left) and Granite Belt-Stanthorpe (right) business managers understood the Critical Temperature Thresholds and Projected 2050's information and thought it useful to enhance their future planning.





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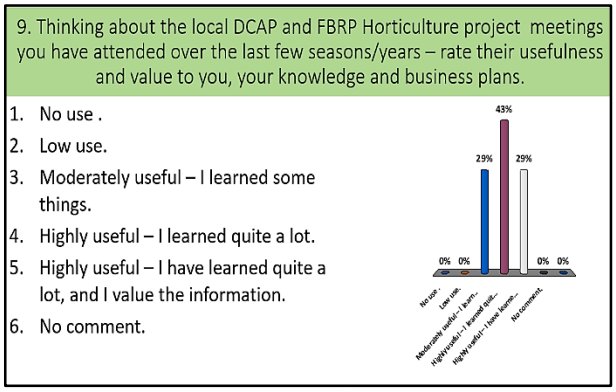
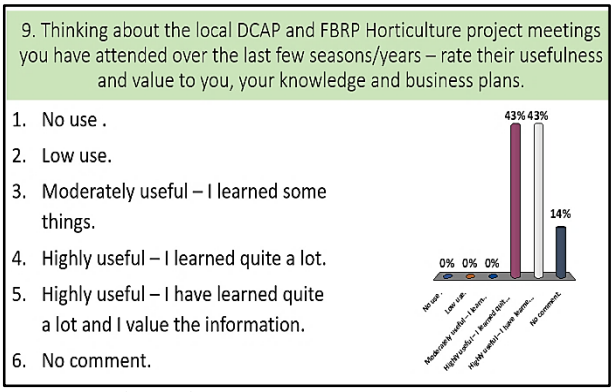
Business managers opinion of the 1, 2-, and 3-month Long Lead Time Forecasts.
Business managers in the Lockyer Valley (left) and Granite Belt (right), value and have been influenced by the ongoing Long Lead Time Forecasting work.

Business managers opinion of the current FBRP and previous DCAP Horticulture project work.





The no comment response was from a business manager's son, who attended for the first time so did not comment on this question

Anonymous June 2025 workshop feedback (Lockyer Valley (left) and Granite Belt (right)) indicates that many locally and nationally important Queensland horticultural business and supply chain managers are highly supportive of and have benefitted from the DCAP and FBRP horticulture focussed project work.

The 4 sequential DCAP and FBRP funded DPI horticulture projects (2018 – 2025) have fostered a loyal following and have made a significant contribution to business managers' knowledge and understanding of a broad range of Forecasting, Climate and Weather issues.

Locally focussed, this targeted, interactive and ongoing work has created interest and fostered significant Farm and Supply Chain Business manager interest and consistent engagement with Project staff. This FBRP and DCAP funded horticultural business focussed work program has been valued by the local industry. It is both rare and pleasing to see the above feedback. This horticulture projects practical content, industry engagement, CTT documents, forecasts, web-tools developed and presented, over recent years and seasons, has benefitted both the industry and Queensland.

Consistent repeat workshop attendance by significant Queensland farm and supply chain business managers, in both the Granite Belt and the Lockyer Valley, has been a highlight of industry engagement throughout this series of "stand alone" horticulture projects. The local face to face workshop sessions held during this last 12 month project have again been well attended. Leading industry managers are interested, in and learning from, this practical, locally focussed climate and forecasting work, as seen in the workshop feedback presented above. Active industry players were the target audience, and it is important to realise that all attendees at all meetings were local growers or supply chain managers e.g. One Harvest Qld supply manager, year-round sweet corn and vegetable suppliers.
Engagement and useable practical information were the hallmark of this horticulture work program and this enticed "time poor managers" to make the time to attend local workshops. A significant number of business managers attended 11 or 12 of the 14 face to face information workshops held locally, July 2018 – June 2025. <u>This is a significant fact and indicates the value of this work to both Lockyer Valley and Granite Belt business and supply chain managers</u>.

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Project Recommendations.

Quality information and knowledge, which is practical and responsive (to industry) developed and presented by knowledgeable and well-respected staff, who are supported and appropriately funded, can drive industry engagement. The evolution of the DCAP and FBRP project work over several project cycles has not only gained traction with industry, but also delivered content and output, which has been actively sought and used by Queensland horticultural business and supply chain managers. Significant extra work was completed in each CTT crop analysis documents – so that each Queensland focussed crop document also included and analysed projected temperature impacts (2050) at all major interstate production locations - e.g. Katherine, Sydney Basin, Manjimup. This extra work, analysis and detail, extends the reach of this Queensland funded work, making the CTT crop documents and information available, informative and relevant to not only Queensland, but also to National Horticultural business and supply chain managers.

Face to Face local meetings and discussions with major growers allowed the project team to obtain regular feedback on industry needs, and to fine tune the CTT analysis documents to make them user friendly, accessible and easily understood by decision makers.
The DCAP 3 Horticulture project team actively engaged and interacted with both Queensland fruit and vegetable and supply chain business managers (e.g. Perfection Fresh/One Harvest/Lite & Easy).

In February this year the Project Team updated HortCarbon Info with the **latest August 2024 National Greenhouse Emissions Factors** to reflect recent small changes in the National Greenhouse Gas Accounts, **ensuring HortCarbon Info** remains **highly accurate**, relevant and up to date.

Extra - Hands on Industry Workshop – requested.
In early June 2025, a HortCarbon Info, "Calculate your own farms emissions" workshop was run in Stanthorpe in response to industry requests. This was organised after a direct request from the SQNNSW Innovation Hub in conjunction with the Granite Belt Growers Association. A number of local businesses had expressed an interest in learning how to use DPI's HortCarbon Info web-tool so that they could assess their farm businesses GHG emissions. The 2 Hr interactive Workshop session was attended by 11 interested local participants – including a large farm business that also runs a vegetable pack-house. Participants used HortCarbon Info to calculate their own business emissions.

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DCAP Horticulture industry Web-tool-update.

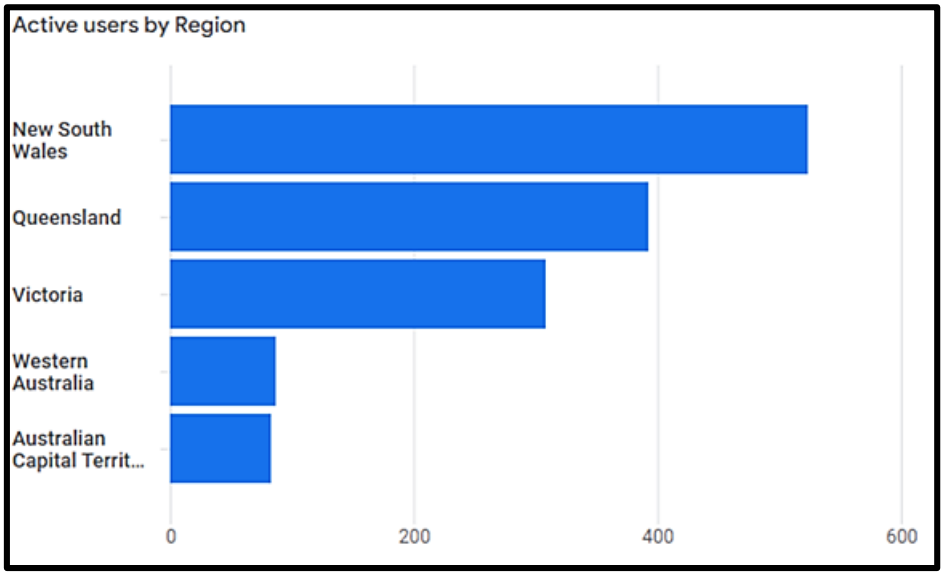
Both DCAP funded web-tools HortCarbon Info and Climate Monitor were made publicly available in July 2022. The DCAP Hort Project Team have maintained and updated the tools annually since they were released. The Greenhous Gas emission factors used by HortCarbon Info were updated in February 2025.

After 3 years the unique DCAP Horticulture and Agriculture web-tools are still heavily used.

Use figures for the last 12 months June 2024-June 2025 – below

Site	Views
Climate Monitor	1524
HortCarbon Info	1364
Total	2888

The whole of Australia is accessing these DCAP funded Horticulture and Agriculture tools.



Note: to be registered as a view in the analytics table above, a user must actively perform a Carbon emissions calculation or interrogate Climate Monitor to analyse recent weather data at a location they have chosen.
The views count in the Table above is of actual use of the tools to perform data analysis.

The Queensland and Australian horticulture industry value and still regularly use DCAP funded webtools HortCarbon Info and Climate Monitor.

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