# Final Report

## Final monitoring and evaluation of Forewarned is Forearmed (FWFA): equipping farmers and agricultural value chains to proactively manage the impacts of extreme climate events (RND4P-16-03-007)

## Qualitative Evaluation Report


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# Abstract

This report presents the findings of the final monitoring and evaluation investigation of the rural research and development (R&D) for profit project titled “Forewarned is Forearmed: managing the impacts of extreme climate events” (FWFA). The final evaluation was commissioned by Meat and Livestock Australia to fulfil the performance reporting requirements under the Commonwealth rural R&D for profit program.

The evaluation included two components, a technical evaluation reporting on project performance with respect to compliance and technical success (Qualitative Evaluation), and a triple bottom line assessment to estimate adoption and impact (Quantitative Evaluation).

The independent final review concluded that the FWFA RND4P project has been a valuable, relevant, effective, and efficient RD&E project. FWFA directly addressed each of the RND4P Program objectives and represents a practical response for the agricultural sector to better understand and adapt to a variable climate.

The project was undertaken in a manner consistent with relevant plans and contracts and delivered against all project objectives. Governance arrangements were strong throughout the project and stakeholders indicated a high level of satisfaction with project governance and management. FWFA partners were largely engaged and satisfied with project progress and adaptability, particularly with respect to project management during the COVID-19 global pandemic.

Overall, the project was well designed and executed with few research gaps. The FWFA project has been presented by stakeholders as a best practice example of a large and complex collaborative R&D project.

The FWFA independent final evaluation has provided FWFA project partners and the government with improved understanding of and ability to communicate the performance of the FWFA project. The review findings, including recommendations and identification of areas for further R&D, may be used by government, research funders, and industry to inform and prioritise future climate or climate related RD&E and to enhance future monitoring and evaluation processes.

# Executive Summary

## Background

This report presents the findings of the final monitoring and evaluation (M&E) investigation of the rural research and development (R&D) for profit project titled "Forewarned is Forearmed: managing the impacts of extreme climate events" (hereafter referred to as FWFA). The FWFA project ran from mid-2017 to end 2022 and was to provide, amongst other outputs, five new BOM forecast products for extreme events in the weeks, months, and seasons ahead. Funding partners included the Australian Government Department of Agriculture, Fisheries, and Forestry (DAFF) as part of the Rural R&D for Profit (RND4P) Program ($6 million), with further cash and in-kind contributions ($8 million) from 14 project partners covering Rural Research and Development Corporations (RDCs), BOM, universities and state departments of agriculture. The final evaluation was commissioned by Meat & Livestock Australia (MLA) which managed the FWFA project on behalf of investment partners.

## Objectives

The independent final evaluation of FWFA assesses and reports on:

1. Whether the project (including funding/budget), was undertaken consistent with relevant plans and contracts.
2. Whether a satisfactory governance arrangement was in place to robustly manage the project.
3. Whether the overall objectives (outputs and outcomes) of the project were achieved.
4. The degree to which project partners (both research providers and investors) were engaged in the project, felt they were able to provide appropriate input, and had their needs met.
5. An assessment of overall 'value' to levy payers and the Commonwealth Government. This valuation took the form of both an ex-ante and ex-poste economic impact assessment.
6. Any recommendations in relation to outstanding issues that may form the focus of future collaborative R&D investment in climate extreme events or other related climate areas.

## Methodology

The evaluation included two components, a technical evaluation reporting on project performance with respect to compliance and technical success (Qualitative Evaluation), and a triple bottom line (TBL) assessment to estimate adoption and impact (Quantitative Evaluation).

The Qualitative Evaluation required:

- Consultation with project partners to assess satisfaction with FWFA project governance, engagement, and overall performance (a list of stakeholders was provided by MLA).
- A project literature review (e.g., milestone reports and budget documents) to assess project progress and delivery of outputs and outcomes consistent with the project's objectives and budgets.
- Adequacy of scientific publications, reports, and communication products.
- Investigation of research gaps and future collaborative investment opportunities.

The Quantitative Evaluation included:

- Investigation of the level of awareness of FWFA products by levy payers in target industries.
- Primary and secondary data collection and modelling of the actual and likely future level of use (adoption) by producers and other end-users of project outputs (e.g., the Bureau of Meteorology's (BOM's) new seasonal forecast products and climate risk management packages). This included consultation with industry and identification of potential producer case studies demonstrating adoption and impact.
- Modelling and estimation of the potential impacts of the FWFA products (with a focus on economic impacts and producer benefits).
- Forecasting of potential industry level impacts and identification of key metrics that may be used to measure and monitor impacts after the project has concluded (e.g., 2 to 5 years after completion of the project).

## Results/key findings

The independent final review concluded that the FWFA RND4P project has been a valuable, relevant, effective, and efficient RD&E project. FWFA directly addressed each of the RND4P Program objectives and represents a practical response for the agricultural sector to better understand and adapt to a variable climate.

The project was undertaken in a manner consistent with relevant plans and contracts and delivered against all project objectives. Governance arrangements were strong throughout the project and stakeholders indicated a high level of satisfaction with project governance and management. FWFA partners were largely engaged and satisfied with project progress and adaptability, particularly with respect to project management during the COVID-19 global pandemic.

Overall, the project was well designed and executed with few research gaps. The FWFA project has been presented by stakeholders as a best practice example of a large and complex collaborative R&D project.

## Benefits to industry

The FWFA independent final evaluation has provided FWFA project partners and the government with improved understanding of and ability to communicate the performance of the FWFA project. The review findings, including recommendations and identification of areas for further R&D, may be used by government, research funders, and industry to inform and prioritise future climate or climate related RD&E and to enhance future monitoring and evaluation processes.

## Recommendations

The independent final review of the FWFA project led to the following recommendations:

*Plans:*

1. Publishing the list of extreme weather events impacting Australian agriculture 1981 to 2017 in a form that would facilitate their use by producers and their advisors.
2. Future projects should allocate resources to engagement with the supply chain/agribusiness. This sector will benefit from FWFA products and may positively influence producer adoption.
3. Collection of data on FWFA product adoption and impact as part of MLA's Business Planning and Evaluation processes. Access to this data would increase confidence in project value.

*Governance:*

4. IP for the six industry-specific and one generic risk management plans prepared as part of FWFA needs to be agreed and recorded in the IP register.

*Engagement:*

5. Ensuring the rice industry receives value from AIA – AgriFutures Australia is a member of AIA and the mid-term recommendation for rice industry engagement through their annual conference (most recently August 2022) is reiterated.
6. Realisation of opportunities around Ag360, chill indexes and Product #6 (extreme Wind) be pursued through AIA.
7. Securing ongoing funding for the FWFA newsletter – to keep project partners, including IAG members, engaged with seasonal climate forecasting and climate risk management.

*Objectives:*

8. Additional forecast products – investigate development and licencing opportunities for other forecast products developed as part of FWFA but not maintained by BOM.
9. Work with partner RDCs to embed risk management plans into their extension tools and programs. MLA and DA are the most advanced in this regard. Processes are also needed to ensure plans are regularly updated.

## Future research

Based on the independent final review of FWFA and associated stakeholder insights, the following areas were identified as opportunities for future collaborative climate extreme and other related climate area RD&E:

- Further training of primary producer advisors and train-the-trainer initiatives in the use of FWFA products.
- Address the inconsistency between the 7-day forecast and ACCESS-S2 products.
- Increase the accuracy of seasonal forecasts.
- Extension of FWFA products from 6 months into the future to 12 months or more.
- Develop industry and location specific extreme event forecasts.
- Produce Product #6 (Extreme Wind) which incorporates a Chill Index.
- Engage the agribusiness/supply chain.
- Further exploration of private investment in the development of tailored forecast.
- Further development of risk management plans including their automation as software and ongoing update of their content post-FWFA.
- Research to understanding social response by primary producers to extreme.

# Table of contents

## List of Tables and Figures

## Acknowledgements

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## Disclaimer

All description, figures, analyses, forecasts, and other details have been prepared in good faith from information furnished to Talia Hardaker and Michael Clarke by other parties. These data are believed to be correct at the date of preparation of this report.

However, it should be noted that predictions, forecasts, and calculations are subject to assumptions which may or may not turn out to be correct and ACRE Economics and AgEconPlus expressly disclaim all and any liability to any persons in reliance, in whole or in part, on the report in total or any part of its contents.

## Abbreviations

| | |
|---|---|
| AgVic | Agriculture Victoria |
| ACO | Agri Climate Outlook |
| AIA | Agricultural Innovation Australia |
| ANU | Australian National University |
| APL | Australian Pork Limited |
| ARC | Australian Research Council |
| AWI | Australian Wool Innovation |
| BCG | Birchip Cropping Group |
| BOM | Bureau of Meteorology |
| CoP | Community of Practice |
| CRC | Cooperative Research Centre |
| CRDC | Cotton Research and Development Corporation |
| CRSPI | Climate Research Strategy for Primary Industries |
| DA | Dairy Australia |
| DAFF | Department of Agriculture, Fisheries, and Forestry |
| DAF-QLD | Department of Agriculture and Fisheries, Queensland |
| DAWE | Department of Agriculture, Water, and Environment (now DAFF) |
| DCAP | Drought and Climate Adaptation Program |
| DEDJTR | Department of Economic Development, Jobs, Transport and Resources, Victoria |
| FWFA | Forewarned is Forearmed |
| GRDC | Grains Research and Development Corporation |
| IAG | Investor Advisory Group |
| IP | Intellectual Property |
| IRG | Industry Reference Group |
| ISFP | Improved Seasonal Forecasts Project (BOM) |
| IT | Information Technology |
| KASA | Knowledge, Attitudes, Skills, Aspirations |
| KPI | Key Performance Indicator |
| M&E | Monitoring and Evaluation |
| MCV | Managing Climate Variability program |
| MER | Monitoring, Evaluation and Reporting |
| MJO | Madden-Julian Oscillation |
| MLA | Meat and Livestock Australia |
| NACP | Northern Australia Climate Program |
| NR | No Response |
| PLG | Program Leaders Group |
| POAMA | Predictive Ocean Atmospheric Model for Australia |
| R&D | Research and Development |
| RD&E | Research, Development and Extension |
| RDC | Research and Development Corporation |
| RND4P | (Australian Government) Rural R&D for Profit Program |
| SARDI | South Australian Research and Development Institute |
| SRA | Sugar Research Australia |
| SSW | Sudden Stratospheric Warning |

| | |
|---|---|
| TBL | Triple Bottom Line |
| TFP | Total Factor Productivity |
| UNE | University of New England |
| UoM | University of Melbourne |
| USQ | University of Southern Queensland |
| VIC | Victoria |
| WA | Wine Australia |
| WP | Work Package |

# 1. Introduction

## 1.1 Evaluation purpose and objectives

This report presents the findings of the final monitoring and evaluation (M&E) investigation of the rural research and development (R&D) for profit project titled "Forewarned is Forearmed: managing the impacts of extreme climate events" (hereafter referred to as FWFA). The final evaluation was commissioned by Meat and Livestock Australia (MLA) which managed the project on behalf of investment partners.

The review assesses and reports on:

1. Whether the project (including funding/budget), was undertaken consistent with relevant plans and contracts.
2. Whether a satisfactory governance arrangement was in place to robustly manage the project.
3. Whether the overall objectives (outputs and outcomes) of the project were achieved.
4. The degree to which project partners (both research providers and investors) were engaged in the project, felt they were able to provide appropriate input, and had their needs met.
5. An assessment of overall 'value' to levy payers and the Commonwealth Government. This valuation took the form of both an ex-ante and ex-poste economic impact assessment.
6. Any recommendations in relation to outstanding issues that may form the focus of future collaborative R&D investment in climate extreme events or other related climate areas.

## 1.2 Approach used to deliver the evaluation

The evaluation was completed by Talia Hardaker of ACRE Economics and Michael Clarke of AgEconPlus and commenced in August of 2022. The evaluation included two components, a technical evaluation reporting on project performance with respect to compliance and technical success (Qualitative Evaluation), and a triple bottom line (TBL) assessment to estimate adoption and impact (Quantitative Evaluation).

The Qualitative Evaluation required:

- Consultation with project partners to assess satisfaction with FWFA project governance, engagement, and overall performance (a list of stakeholders was provided by MLA).
- A project literature review (e.g., milestone reports and budget documents) to assess project progress and delivery of outputs and outcomes consistent with the project's objectives and budgets.
- Adequacy of scientific publications, reports, and communication products.
- Investigation of research gaps and future collaborative investment opportunities.

The Quantitative Evaluation included:

- Investigation of the level of awareness of FWFA products by levy payers in target industries.
- Primary and secondary data collection and modelling of the actual and likely future level of use (adoption) by producers and other end-users of project outputs (e.g., the Bureau of Meteorology's (BOM's) new seasonal forecast products and climate risk management packages). This included consultation with industry and identification of potential producer case studies demonstrating adoption and impact.

- Modelling and estimation of the potential impacts of the FWFA products (with a focus on economic impacts and producer benefits).
- Forecasting of potential industry level impacts and identification of key metrics that may be used to measure and monitor impacts after the project has concluded (e.g., 2 to 5 years after completion of the project).

A meeting was held with representatives from MLA (George Waldthausen, Michelle Ford, and Russell Pattinson) prior to contracting to agree the final scope and approach for the evaluation components (e.g., number of end-user surveys and case studies required). Project tasks included an inception meeting, information exchange, desktop review, development of an evaluation framework, consultation with stakeholders, assessment of FWFA impacts across the TBL, and project reporting.

Throughout the evaluation process, regular communications and progress updates were discussed with FWFA project coordinator Russell Pattinson and MLA project manager Michelle Ford. As the evaluation progressed there were some challenges obtaining sufficient responses from industry stakeholders for the Quantitative Evaluation. As a result, a variation was enacted to split the Qualitative and Quantitative Evaluations into two separate reports. This report represents the Qualitative Report and was completed in February 2023. The Qualitative Evaluation report has been developed to fulfil the FWFA project's final reporting requirements under the RND4P Program for the Commonwealth. Delivery of the Quantitative Evaluation was extended to June 2023. This enabled the evaluation team to undertake additional industry engagement to ensure the quality and robustness of the analysis.

## 1.3 FWFA Project background

Australian farmers and agribusiness operate in one of the most variable climates of any country in the world, with extreme events and climate variability the largest drivers of fluctuations in annual agricultural income and production. The FWFA project, led by MLA, ran from mid-2017 to end 2022 and was to provide, amongst other outputs, five new BOM forecast products for extreme events in the weeks, months, and seasons ahead. Funding partners included the Australian Government Department of Agriculture, Fisheries, and Forestry (DAFF[1]) as part of the Rural R&D for Profit (RND4P) Program ($6 million), with further cash and in-kind contributions ($8 million) from 14 project partners covering Rural Research and Development Corporations (RDCs), BOM, universities and state departments of agriculture – Table 1 (below).

[1] Formerly the Department of Agriculture, Water and the Environment (DAWE).

Table 1: FWFA Investment by Project Partner (July 2017 to December 2022)

| **Funding Partner (cash input)** | **$** |
|---|---|
| Managing Climate Variability (MCV) Program – Grains RDC (GRDC), MLA, AgriFutures Australia, Sugar Research Australia (SRA) and Cotton RDC (CRDC) | 1,500,000 |
| Wine Australia (WA) | 250,000 |
| Dairy Australia (DA) | 250,000 |
| MLA extra | 250,000 |
| GRDC extra | 250,000 |
| AgriFutures Australia extra (Rice R&D program) | 150,000 |
| Australian Pork Ltd (APL) | 25,000 |
| **R&D Partner (cash input)** | **$** |
| University of Melbourne (UoM) | 180,370 |
| BOM | 250,000 |
| University of Southern Queensland (USQ) | 255,000 |
| Department of Agriculture Queensland (DAF-QLD) | 200,000 |
| Australian Government – RND4P (cash input) | 6,198,942 |
| **In-kind contributions** | **$** |
| South Australian R&D Institute (SARDI), Agriculture Victoria (AgVic), Monash University, DAF-QLD | 4,803,123 |
| **Total** | **14,562,435** |

Source: FWFA Budget Spreadsheet

## 1.4 FWFA project objectives

Key FWFA project objectives were (sourced from the final evaluation project brief):

- Identification of areas for improvement in the performance of seasonal climate forecasts.
- Development, trialling, and subsequent operationalisation of new BOM forecast products for extreme events in the weeks, months, and seasons ahead.
- Development of risk management packages for extreme events for specific agricultural sectors, and for agriculture more generally.
- Communicating the progress of the project through a variety of media platforms.

There were six main agricultural sectors of focus for the project (1) northern red meat, (2) southern red meat, (3) grains, (4) dairy, (5) sugar, and (6) wine grapes with additional support provided by the cotton, pork, and rice industries.

## 1.5 Major challenges over project period

There were several challenges to the FWFA project over the course of its operation. These included:

- The COVID-19 pandemic which negatively impacted:
  - Meetings with producer orientated Industry Reference Groups (IRGs) to get input to and feedback on experimental products.
  - Project management meetings (Program Leaders Group (PLG), Investor Advisory Group (IAG)).
  - Face-to-face conferences / workshops to communicate FWFA progress and new products.

- Delays in the completion of the project due to COVID-19 and the delayed launch of ACCESS S2[2] required the project to be extended for 12 months (a no cost extension). In many ways this was a positive as it allowed more time to communicate / extend the new products to farmers.
- Less engagement with the supply chain (agents, processors etc) than desired due to resource constraints.
- As a result of less travel / meetings and other savings the FWFA project was able to hold an open call with project partners to identify new projects that would promote FWFA outputs to farmers. New projects were identified and commissioned in calendar 2022.

[2] ACCESS-S (Australian Community Climate and Earth-System Simulator – Seasonal) is the Bureau of Meteorology's climate modelling system used for outlooks on weekly through to seasonal timescales. For further information see: http://www.bom.gov.au/research/projects/ACCESS-S/

# 2. FWFA delivery consistent with project plans and contracts

This chapter provides an assessment of whether the FWFA project (including funding/budgets) was undertaken consistent with project plans and contracts.

## 2.1 Research investment

Planned investment in project management and work packages (WP) is shown in Table 2.

Table 2: FWFA Investment Allocation by Project Activity (1 July 2017 to December 2022)

| **Project Activities** | **$** |
|---|---|
| Project Management | 1,497,515 |
| WP1: User needs and forecast system development<br>WP2: Extreme event forecast products development and delivery | 6,832,920 |
| WP3: Farmer and advisor application development<br>WP4: Extension and training | 6,232,000 |
| **Total** | **14,562,435** |

Source: FWFA Budget Spreadsheet and FWFA 'Plan on a Page'.

Breakdown of project budget into specific work packages is not straightforward – individual agency contracts span multiple packages. Funds have been committed as per individual agency contracts and therefore align with Table 2 budgets. The exception to this alignment is the underspend caused by COVID-19. COVID-19 underspend has been reallocated to extension to encourage farmer uptake of FWFA forecast and risk management products. Additional projects included:

- Business Case for Developing a Heat Load Index for Cattle in Australia (USQ project), A FWFA investment of $100,000 plus $95,000 in-kind contribution by USQ.
- Communication and Extension Project (UoM, AgVic, Birchip Cropping Group (BCG)) – aimed at increasing producer awareness, skills in use, and evaluation of the utility of FWFA products, a FWFA investment of $202,499 plus partner in-kind support of $71,223.
- Development and Testing of an Interactive Climate Risk Management Package (SARDI, Uni Adelaide) – the project will deliver a prototype interactive, web-based probabilistic forecast with tactical climate risk decisions. A FWFA cost of $121,000 plus $456,749 in in-kind contribution.
- Four Communication Videos for FWFA Products in Northern Australia (MLA, USQ) – Video 1: Burst Forecast, Video 2: Uses of Burst Forecast, Video 3: Deciles and Extremes, and Video 4: Probability of Exceedance. A FWFA cost of $45,000.
- Three Communication Videos for FWFA Products in Southern Australia (MLA and delivered by Laundry Lane) – two video case studies plus an overview video. Audience for videos to include agricultural advisors, producers, banks, supply chain. A cost to FWFA of $39,903.

In total, an additional $508,402 was reallocated to FWFA communication and extension, approximately 3.5% of the FWFA budget. In addition, reallocated FWFA funds were supported by an additional in-kind contribution of $622,972 from project partners.

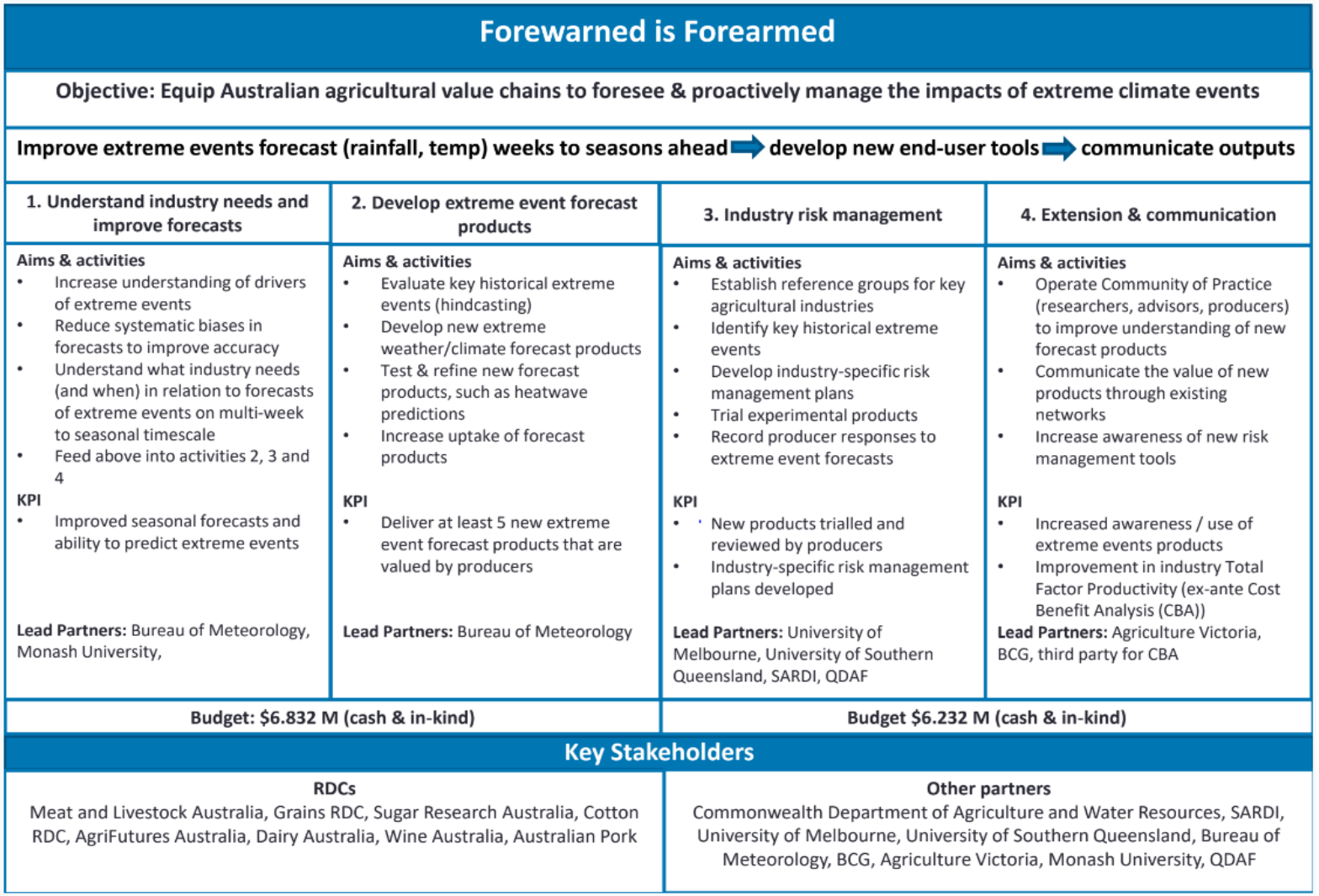
## 2.2 FWFA overview

As part of the FWFA project, BOM completed research to deliver long-term forecasts of the likelihood of climate extremes using its new seasonal prediction system, ACCESS-S. Over the course of the project, ACCESS-S was upgraded to ACCESS-S2.

FWFA project activities included research, product development and extension teams, representing a range of industries, working with farmers and farm consultants, to develop and interface extreme weather event forecasts with agricultural decisions. Project teams were tasked with developing risk management strategies to proactively prepare for extreme weather events, as well as extending project outputs to producers and advisors.

FWFA was to provide options for a range of farm level and agricultural industry operational and investment decisions, as well as decreasing the impact of extreme climate events on farm and industry profit. The project is summarised in Figure 1.

Figure 1: FWFA Project 'Plan on a Page'



## Forewarned is Forearmed

**Objective: Equip Australian agricultural value chains to foresee & proactively manage the impacts of extreme climate events**

**Improve extreme events forecast (rainfall, temp) weeks to seasons ahead → develop new end-user tools → communicate outputs**

| 1. Understand industry needs and improve forecasts | 2. Develop extreme event forecast products | 3. Industry risk management | 4. Extension & communication |
|---|---|---|---|
| **Aims & activities**<br>• Increase understanding of drivers of extreme events<br>• Reduce systematic biases in forecasts to improve accuracy<br>• Understand what industry needs (and when) in relation to forecasts of extreme events on multi-week to seasonal timescale<br>• Feed above into activities 2, 3 and 4<br>**KPI**<br>• Improved seasonal forecasts and ability to predict extreme events<br>**Lead Partners:** Bureau of Meteorology, Monash University, | **Aims & activities**<br>• Evaluate key historical extreme events (hindcasting)<br>• Develop new extreme weather/climate forecast products<br>• Test & refine new forecast products, such as heatwave predictions<br>• Increase uptake of forecast products<br>**KPI**<br>• Deliver at least 5 new extreme event forecast products that are valued by producers<br>**Lead Partners:** Bureau of Meteorology | **Aims & activities**<br>• Establish reference groups for key agricultural industries<br>• Identify key historical extreme events<br>• Develop industry-specific risk management plans<br>• Trial experimental products<br>• Record producer responses to extreme event forecasts<br>**KPI**<br>• New products trialled and reviewed by producers<br>• Industry-specific risk management plans developed<br>**Lead Partners:** University of Melbourne, University of Southern Queensland, SARDI, QDAF | **Aims & activities**<br>• Operate Community of Practice (researchers, advisors, producers) to improve understanding of new forecast products<br>• Communicate the value of new products through existing networks<br>• Increase awareness of new risk management tools<br>**KPI**<br>• Increased awareness / use of extreme events products<br>• Improvement in industry Total Factor Productivity (ex-ante Cost Benefit Analysis (CBA))<br>**Lead Partners:** Agriculture Victoria, BCG, third party for CBA |
| **Budget: $6.832 M (cash & in-kind)** | | **Budget $6.232 M (cash & in-kind)** | |

## Key Stakeholders

| RDCs | Other partners |
|---|---|
| Meat and Livestock Australia, Grains RDC, Sugar Research Australia, Cotton RDC, AgriFutures Australia, Dairy Australia, Wine Australia, Australian Pork | Commonwealth Department of Agriculture and Water Resources, SARDI, University of Melbourne, University of Southern Queensland, Bureau of Meteorology, BCG, Agriculture Victoria, Monash University, QDAF |

NB: The final FWFA 'plan on a page' did not include WP4 KPI2 improved Total Factor Productivity (TFP) which was removed as per mid-term review (Clarke and Alford 2020) recommendations.

## 2.3 Delivery against the project/operating plan

The FWFA Project/Operating Plan was finalised, submitted, and accepted by the DAFF prior to June 2018. Delivery against project plan requirements, WP1 through WP4, is shown in the tables below.

Table 3: Delivery of FWFA **WP1** 'Understand Industry Needs and Improve Forecasts'

| **Work Package 1: Understand industry needs and improve forecasts** | |
|---|---|
| **Project Plan Requirements** | **Delivery Against Requirement** |
| Increase understanding of drivers of extreme events. | • BOM developed computer code to extract extreme event leading patterns.<br>• Sci paper: "Causes and Predictability of Aust Low Minimum Temperatures".<br>• Tech paper: "Role Tropical Systematic Errors Simulating Hot Aust Summers".<br>• "Role Antarctica plays in Aust weather via the Southern Annular Mode".<br>• "Role Madden-Julian Oscillation (MJO) driving rainfall extremes by season".<br>• Development of sea breeze parametrisation. Sea breeze parametrisation incorporated into atmospheric model used by ACCESS-S. |
| Reduce systematic biases forecasts to improve accuracy. | • ACCESS-S modelling error diagnosis tools developed and applied.<br>• Minimum temperature biases identified and tested using hindcasts.<br>• Hot summer forecasting bias identified and addressed.<br>• Inconsistency between the BOM 7 day forecast and week one of FWFA products identified but "fix" beyond the scope of FWFA. |
| Industry needs, extreme events forecasts. | • User Needs Synthesis Report finalised and published 2018.<br>• Ongoing refinement of needs through IRGs. |
| Feed above into WP2, WP3, and WP4. | • The increased understanding of the drivers of extreme events, refinement of modelling tools, and an understanding of industry needs were communicated to other work package teams via the PLG and IAG. |

Source: FWFA 'Plan on a Page', milestone reports and stakeholder consultation

**WP1 Key Performance Indicators (KPIs)**

'Improved seasonal forecasts and ability to predict extreme events'.

**Delivery of WP1 KPIs**

WP1 has delivered its single KPI. Knowledge of the drivers of extreme climate events has been successfully researched and the relevant research has been published in a variety of forms including peer reviewed journals. Systematic biases in the ACCESS-S model have been identified and mostly rectified. The inconsistency between the BOM 7 day forecast and seasonal FWFA products remains. A refined forecasting model, ACCESS-S2, has been launched and this tool supports 5 more accurate FWFA extreme climate event seasonal forecasts. An understanding of what is important to six agricultural industries (northern red meat, southern red meat, grains, dairy, sugar, and wine grapes) in terms of seasonal forecasting of extreme climate events has been developed and communicated to the managers of other WPs.

Table 4: Progress Against FWFA **WP 2** 'Develop Extreme Event Forecast Products'

| **Work Package 2: Develop extreme event forecast products** | |
|---|---|
| **Project Plan Requirements** | **Delivery Against Requirements** |
| Evaluate key historical extreme events (hindcasting). | • Historical extreme climate events have been used to calibrate and prove FWFA forecast products. For example, scientific papers addressing limits of ACCESS-S ability to forecast Minimum Temperatures out to 30 days have been prepared and biases identified and tested using hindcasts. |
| Develop new extreme weather/climate forecast products to aid agricultural decision-making. | • Five forecast products contracted and delivered.<br>• Product #1 and #2 launched by Minister for Agriculture and Minister for Environment 1, November 2021. Products #3 to #5 launched 24 June 2022.<br>• **Product #1 Chance of Extreme Rainfall and Temperature Maps**. These maps indicate the chance of having extreme (deciles 1&2 and deciles 9&10) rainfall, maximum and minimum temperature for the weeks, months, and seasons ahead. Product #1 featured in the BOM's August to October Winter 2022 Climate Outlook (Media Release and ABC Landline).<br>• **Product #2 Location Specific Rainfall and Max/Min Temperature Decile and Quintile Bars**. Bars indicate the shift in probabilities compared to usual. Forecasts available for the weeks, fortnights, months, and seasons ahead. Charts available as "pop-ups" upon clicking on the maps (or searching for a location). Product #2 is of value to agriculture and emergency services. Producers using this product experienced a "Eureka moment", understanding the statistical nature of forecasts and that even if high rainfall is most likely, there is still a statistical probability of little or no rainfall.<br>• **Product #3 Climagram.** Location-specific timeseries graphs showing the forecast (and past observations) of rainfall totals and max/min temperature for the coming weeks and months. Climagrams are useful for making production decisions such as when to apply nitrogen to ryegrass or when to make the seasonal switch from ryegrass to kikuyu in Victoria (VIC).<br>• **Product #4 Probability of Exceedance.** Chance of any rain, historical and forecast. This is a complex product that is more likely to be used by advanced primary producers and agricultural advisors e.g., fertiliser adjustments to deliver target yield. Product #4 also has potential to be used by other complex related industries. For example, modification of historical data in the light of recent experience is a major adjustment mechanism within the insurance industry (The Centre for International Economics, 2014).<br>• **Product #5 – 3-day Burst Forecast**. What chance of a 3-day burst of rainfall? Good for assessing autumn break in Southern Australia and wet season onset in Northern Australia. Ideal for haymaking, fruit harvest, crop protection decisions, timing of sugar harvest. Historical probability of rainfall spans the period 1960 to 2019. |
| Test and refine new products. | • All five FWFA products were tested and refined following feedback from the PLG, the Community of Practice (CoP) and all six, industry based IRGs.<br>• Consultation included IRG workshops and CoP webinars.<br>• Feedback was also provided by users clicking on a feedback button on the experimental products website. |
| Increase uptake of seasonal prediction products. | • FWFA products received approximately 750,000 views between November 2021 launch and early July 2022 (588,181 up to May 2022).<br>• There is a commitment by BOM to support these five FWFA products in perpetuity. |

**WP2 Key Performance Indicators**

'Deliver at least five new extreme event forecast products that are valued by producers'.

**Delivery of WP2 KPIs**

Five seasonal forecast products have been delivered by the FWFA project. BOM is committed to support these five products in perpetuity. The products are superior to the previous BOM offering which typically provided a single piece of information (i.e., above or below median). FWFA products provide information such as "Out of 100 model runs, for your location 32 models landed on decile 1&2 for the next 3 months, and only 8 model runs fell on Decile 9&10. So, while all options are still possible, it shows the swing towards increased chances of a drier three months". This type of forecast has made more sense for primary producers than simple variation on the median explanations.

A decision was made by the project not to support a planned sixth product, 'Product #6 Extreme Wind and Chill'. BOM notes that it has less capacity in forecasting wind when compared to heat, cold, and rain. The opportunity to collaborate with the Sheep Cooperative Research Centre (CRC) and its AskBill product (now known as Ag360) which has a chill index was explored but little collaborative progress was made. It is understood that Ag360 is driven by a different BOM forecast ($5km^2$ zones). With the wind up of the Sheep CRC, Ag360 has been transferred to the University of New England (UNE).

Table 5: Progress Against FWFA **WP 3** 'Industry risk management'

| **Work Package 3: Industry risk management** | |
|---|---|
| **Project Plan Requirements** | **Delivery Against Requirements** |
| Establish reference groups for key agricultural industries. | • Industry Engagement Plans and IRGs established for northern red meat, sugar, southern red meat, dairy, grains, and wine grapes.<br>• Other FWFA partner industries (pork, cotton, rice) engaged on a more *ad hoc* basis, through their respective RDCs and participation in the CoP.<br>• Northern Red meat engaged in FWFA product development via the Northern Australia Climate Program (NACP) meetings. Meetings held with sugar in late 2019. Grains met March 2020. Southern red meat and dairy met June 2020. Wine grapes met late 2020. |
| Identify key historical extreme events. | • In 2018, BOM prepared a spreadsheet identifying extreme weather events which had a significant impact on agriculture between 1981 and 2017.<br>• The spreadsheet was made available to all FWFA partners (including the IRGs), and comment was provided on the suitability of identified events for development of forecast and risk management products. Results informed the user needs analysis of WP1. |
| Develop industry specific risk management plans. | • Partners contracted to deliver a generic climate risk management plan and a plan for each of meat (northern and southern), dairy, grains, wine grapes, and sugar.<br>• Researchers worked with IRGs to collate operational, tactical, and strategic responses to extreme climate events.<br>• Information summarised in 2019 report to MLA outlining *'Methods to analyse the risk and returns of climatically sensitive decisions*'.<br>• SARDI further developed methods for linking forecasts to grower decision-making, risks and return from climatically sensitive decisions.<br>• In September 2019, a draft generic risk management plan was prepared by SARDI, UoM, USQ, DAF-QLD and AgVic.<br>• In May 2022, draft risk management frameworks and toolkit documents have been prepared for dairy, northern red meat, southern red meat, sugar, grains, and wine grapes. Documents detail concepts and provide worked examples of a climate sensitive risk and a subsequent decision framework.<br>• The final versions of the climate risk management plans will be submitted with FWFA Project Milestone 12 (Due at the end of calendar year 2022).<br>• Outside of FWFA, SARDI and the University of Adelaide have secured funding to develop an interactive Climate Risk Management package which will build on static paper-based products prepared as part of this project (Milestone 10). |
| Trial experimental products. | • IRGs, the PLG and CoP selected, tested, and refined FWFA forecast and risk management products.<br>• Feedback on draft risk management frameworks and toolkits was that a brief web version would be valuable (Milestone 10).<br>• UoM responded to this feedback and developed four prototype webpages and a simple excel tool for industry review.<br>• Feedback from MLA and DA resulted in further simplification of the webpage idea. These revised frameworks will be housed on RDC webpages – e.g., MLA's Producer Advisor Network.<br>• An excel based risk management tool is now available for download. It has been developed so that producers can assess on-farm extreme event risk. |

| **Work Package 3: Industry risk management** | |
|---|---|
| **Project Plan Requirements** | **Delivery Against Requirements** |
| Record producer responses to extreme event forecasts. | • In August 2022 it is too early to report specific producer feedback on extreme event forecasts. Forecast products #1 and #2 released November 2021. Forecast products #3 to #5 released 24 June 2022.<br>• As of January 2023, there had been over 1.34 million views of the FWFA BOM product pages, although not all views will be primary producers. |

**WP3 Key Performance Indicators**

'New products trialled and reviewed by producers'.

'Industry-specific risk management plans developed'.

**Delivery of WP3 KPIs**

New forecast and risk management products have been trialled with producers via IRGs, the PLG, and the CoP. Producers in northern red meat, sugar, southern red meat, dairy, gain, and wine grapes have been effectively engaged. Production of risk management plans is on track for finalisation by December 2022.

A recommendation was made as part of the mid-term review to publish the listing of extreme weather events, 1981 to 2017, that have impacted Australian agriculture. This has not been done and should be delivered as part of FWFA completion.

**Recommendation 1**

Publish the listing of extreme weather events, 1981 to 2017, that have impacted Australian agriculture.

Table 6: Progress Against FWFA **WP 4** 'Extension and communication'

| **Work Program 4: Extension and communication** | |
|---|---|
| **Project Plan Requirements** | **Delivery Against Requirements** |
| Operate the CoP. | • CoP established by BCG and transferred to the FWFA project. Members include researchers and regional reference groups across six industries.<br>• Membership includes many climate science communicators.<br>• Focus is on better understanding farmer audiences and collaborating for more effective research products and product extension.<br>• Meeting invitations sent to 113 individuals, with an average of 24 participating at each monthly webinar.<br>• Membership publicised through Climate Kelpie, Twitter, and Facebook.<br>• The BCG provides FWFA updates to the CoP via the monthly webinar.<br><br>Examples of relevant CoP webinar presentations include:<br>• April 2021 – land-atmosphere interactions and their effect on Australian rainfall, an explanation of FWFA forecast products #4 and #5 (BOM).<br>• July 2021 – Effect of climate change on hailstorms (BOM).<br>• August 2021 – Machine learning, and seasonal climate forecasting (ARC).<br>• October 2021 – What is going on in the Indian Ocean (Agricultural Innovation Australia (AIA)).<br>• October 2021 – Summary of Model Development for the FWFA products and moving from ACCESS-S to ACCESS-S2 (BOM).<br>• February 2022 – Results of farm case studies – FWFA, Consensus seasonal forecasting project, and the AgScore project (Australian National University (ANU)).<br>• April 2022 – Quantitative market research using seasonal forecasts (BOM and Climate Services Australia). |
| Communicate the value of new products developed through existing networks. | Each of the project's lead partners has tapped existing networks, for example:<br>• UoM: VIC Govt policymakers, farmer and advisor presentations focussing on Sheep and Dairy, FWFA Product #1 & #2 Ministerial launch and media coverage. Webinar to launch all 5 FWFA products attended by 104 individuals. UoM website references all FWFA publications and products.<br>• BOM: presentations to GRDC, SRA, NACP, CoP briefings, and YouTube. BOM website hosts 5 FWFA products and project publications.<br>• USQ: Roger Stone's Forecast Newsletter, presentation to Beef 2021, Rangelands Conference, NACP, Northern Territory Cattlemen's Assoc., SRA, and Landcare.<br>• SARDI: wine industry "Next Gen" workshop, GRDC's southern climate meetings, GRDC nitrogen topdressing case study, Climagram workshop in Loxton, presentation to Australian Farm Institute's climate change forum.<br>• AgVic presentations to farmer groups on climate forecasts and Graeme Anderson frequently promotes FWFA products during 'The Break'.<br>• PLG/IRG webinars to review prototypes, and operational FWFA products.<br>• Up to January 2023 the project produced a total of six FWFA Newsletters, refined the Climate Kelpie website and produced a promotion page on both the UoM and BOM websites. |

| **Work Program 4: Extension and communication** | |
|---|---|
| **Project Plan Requirements** | **Delivery Against Requirements** |
| | • Additional FWFA extension projects contracted in 2022 will also make use of established stakeholder networks and include: awareness raising of FWFA products (webinars), development of use skills (eLearn modules), 20 industry talks around FWFA outputs, 4 farmer-focussed case studies, social media and news via Climate Kelpie, an interactive climate risk management package, articles in RDC publications, and 7 communication videos covering southern and northern Australia. |
| Increase awareness of new risk management tools. | • When finalised in late 2022, risk management tools will be communicated to producers, farm advisors, and others using the CoP, existing networks and the additional FWFA investment in extension contracted early 2022.<br>• Additional FWFA investment in extension and relevant to risk management tool awareness raising includes the UoM, AgVic and BCG Communication and Extension Project, development of an Interactive Climate Risk Management Package (SARDI, Uni Adelaide) and the planned communication videos. |

**WP4 Key Performance Indicators**

'Increased awareness/use of extreme events products'.

('Improvement in industry Total Factor Productivity' removed from the final Plan on a Page).

**Delivery of WP4 KPIs**

Awareness of FWFA extreme event products has been raised through the CoP, the use of existing networks, and additional communication and extension activities funded with COVID-19 meeting / conference savings. CoP participation in FWFA activities included receipt of information on project outputs by 113 science-focussed stakeholders and feedback on outputs provided through project-initiated webinars. Underspend caused by COVID-19 generated an additional $522,509 for investment in communication and extension which was matched by a further $622,972 (mostly in-kind) from project partners. Investment of COVID-19 underspend in additional extension activities will make further contributions to raising awareness of FWFA products.

**Recommendation 2**

Future projects should allocate resources to engagement with the supply chain/agribusiness. This sector will benefit from FWFA products and may positively influence producer adoption.

## 2.4 Communication plan

The FWFA Communication Plan's objectives were to identify target audiences, identify and service existing channels to build awareness, schedule activities and align corresponding budgets, ensure that stakeholders adhere to communication protocols, and complete a review and annual update of the plan. The plan has not been updated since it was approved in June 2018.

While the Communication Plan was not updated, communication has been a major focus of the extended final twelve months of FWFA and a comprehensive program of activities (e.g., eLearning modules, webinars, industry talks, explanatory case studies, social media, RDC articles, and communication videos) has been implemented.

While not updated, the Communication Plan and resulting program of activities, has been comprehensive and appropriate.

### Publications, reports, and communication products

Examples of publications, reports and communication products delivered since the mid-term review in 2020 include:

Press releases

- Joint Ministerial press release on launch of FWFA products.
- BOM press release announcing FWFA product release.

Media appearances – press and TV

- Routine and numerous including BOM staff on radio/TV explaining seasonal outlook.
- Examples include explanation of new FWFA products on ABC Landline.
- Project explanation to Farm Weekly and Rural Queensland Today.

Media mentions for release of new products

- Press releases picked up by Farm Online, Farm Weekly, Stock Journal, The Land, Queensland Country Life, social media (Twitter, Facebook, LinkedIn), North QLD Register, Dubbo News, Kalgoorlie News, Mirage News, Kiama News, etc.

Social Media

- Twitter – BOM tweets.
- Facebook https://fb.watch/dROUFKv5ox/.
- LinkedIn – BOM posts.

Brochures, fact sheets, posters, and newsletters

- Newsletters released February 2020, June 2021, February 2022, and October 2022.

Webpages

- Refining web page for Climate Kelpie website. http://www.climatekelpie.com.au/index.php/forewarned-forearmed/
- FWFA project promo page on UoM https://sustainable.unimelb.edu.au/research/research-clusters/climate-transformations/research/forewarned-is-forearmed
- UoM published FWFA webinars https://www.piccc.org.au/resources/videos-webinars/
- BOM project promo page http://www.BOM.gov.au/research/projects/FWFA/

Webinar and podcasts

- Primary Industries Climate Challenges Centre Videos and webinars | Primary Industries Climate Challenges Centre (piccc.org.au)
- FWFA: FWFA | Primary Industries Climate Challenges Centre (piccc.org.au)
- Podcast: Extreme event episodes for approval - Google Drive

Project presentations

- Milking the Weather: Summer 2018-19 climate and related management strategies update for Victoria Dairy Farmers – Dale Grey.
- Heat Stress and Milk Production: a literature review and analysis of eastern Australian data – Rachelle Meyer.

Peer-reviewed scientific papers

- Cowan, T., Wheeler, M.C., Sharmila, S., Narsey, S., de Burgh-Day, C. (2021) Forecasting northern Australian summer rainfall bursts using a seasonal prediction system. Weather and Forecasting. https://doi.org/10.1175/WAF-D-21-0046.1
- Meyer, R. S., Graham, A-M., Hepworth, G and Eckard, R.E., 2021. Using milk tanker pickup and weather station data to quantify the impacts of heat stress on milk production in Australia. 24th International Congress on Modelling and Simulation, Sydney, NSW, Australia, 5 to 10 December 2021 mssanz.org.au/modsim2021

Scientific conference presentations

- Deb Hudson (December 2021) American Geophysical Union – Forecasts for agricultural decision making on sub-seasonal to seasonal timescales.
- Andrew Marshall (February 2022) International Conference on Southern Hemisphere Meteorology and Oceanography conference – MJO impacts on Australian climate extremes.

Other

- Forewarned is Forearmed mini-conference (6-7th December 2022) held in Melbourne, VIC. The 'mini conference' included FWFA's stakeholders (funding bodies, research and extension providers, government and producers) and related climate activities. The purpose of the conference was to provide attendees with a summary of the achievements of FWFA and an overview of activities being undertaken in related climate areas, and to explore what gaps exist in the development of tools to assist in the management of agricultural climate risk.

A complete list of FWFA project publications is available at https://piccc.org.au/resources/research-publications/FWFA_publications.html

## 2.5 Risk management plan

A Risk Management Plan was prepared for the project and three types of risk were identified: 1) project management, 2) science, and 3) communication. A logical process has been used to work through potential causes/sources of risk, potential impacts, existing controls, ratings on likelihood, ratings on consequences, and additional mitigation strategies.

The Risk Management Plan was comprehensive and complete and required no changes only monitoring as the project unfolded. The mid-term review recommendation that risks be reviewed at each IAG and PLG meeting was not adopted. However, project risks were informally managed throughout the project (e.g., response to COVID-19) by MLA and the project coordinator.

## 2.6 Monitoring, evaluation, and reporting (MER) plan

A comprehensive MER Plan was also prepared for FWFA. The MER Plan employed a logical framework that addressed processes used during the project; stakeholder engagement achieved; practice change observed; practice change measured; and general impact. The framework examined: 1) what did we do, 2) how well did we do it, 3) is anyone better off, and 4) is the industry better off. The MER Plan proposed collection of baseline data by survey in 2018 and measures of progress in 2020 and 2022.

The mid-term review noted that the MER Plan was too ambitious in the number of metrics it planned to address, and the volume of data required. A review and simplification of the MER Plan was recommended. This did not occur nor did collection of baseline data nor measures of progress following FWFA output adoption. Delayed generation of FWFA forecast and risk management products worked against collection of adoption data. The project did invest in social research to determine producer attitudes to seasonal climate forecasts (i.e., Kuehne 2022 and Taylor 2021).

Access to FWFA adoption data would facilitate further assessment of project value. Some data was collected as part of this final project evaluation. However, it is recommended that adoption and impact data be collected as part of MLA's Business Planning and Evaluation processes. Access to this data would increase confidence in project value.

**Recommendation 3**

Collection of data on FWFA product adoption and impact as part of MLA's Business Planning and Evaluation processes. Access to this data would increase confidence in project value.

## 2.7 Response to mid-term review project plan recommendations

Eight recommendations were made as part of the mid-term review and these, together with the project's response, are summarised in Table 7.

Table 7: Response to Mid-term Recommendations – Project Plans

| Mid-term Review Recommendation | FWFA Management Response |
|---|---|
| Additional funds need to be identified for adoption especially in relation to the training of primary producers. | Unallocated FWFA funds were directed to communication and extension. |
| The listing of extreme weather events, 1981 to 2017, that have impacted Australian agriculture developed as part of WP1 requires publishing so that farmers and their advisors have information on the frequency and type of extreme climate events in their area and industry. | User needs analysis circulated internally amongst FWFA partners but not published. Momentum for publishing lost after Luke Shelly, BOM left the project. This is a project gap and requires followed up action. |
| Remove WP4, KPI2 from the project plan - improvement in TFP is an unsuitable measure of project success and is determined by a range of innovations including other on-farm adaptations to climate variability. | TFP removed as a KPI from the project plan as recommended. |
| Project title and objectives identify the importance of engagement with agribusiness value chains and this aspect of project plans needs to be addressed either through IRGs or the CoP and preferably include agribusiness investment in the project. | Less engagement with the supply chain (agents, processors, etc.) than desired due to resource constraints (final evaluation project brief). The decision not to engage supply chains was made prior to COVID-19. |
| The project Communication Plan was to be updated annually and post project mid-point review is the ideal time to update the plan especially in relation to awareness raising, extension measures and adoption opportunities. | Communication Plan was not updated. However, communication was a major focus of the (extended) final twelve months of the project. |
| The FWFA project Risk Management Plan should be reviewed at each IAG and PLG meeting. | Risk Management Plan not reviewed at IAG and PLG meetings. However, project risks (such as COVID-19) were informally managed throughout the project by MLA and the project coordinator. |
| Project mid-point provides an ideal opportunity to update and simplify the MER plan. The number of metrics it intends to address, and the volume of data required is too ambitious. | MER plan not reviewed. |
| It is important that pre-adoption of FWFA products, baseline data be collected in 2020 so that changes in practice observed, measured and their general impact can be reported with confidence in 2022. | Baseline data on adoption was not collected. Indeed, baseline data expected to be zero as FWFA involves totally new products. Market research was undertaken to better understand producer views of seasonal climate forecasts. Also, NACP project might provide useful information on adoption of seasonal forecasts for northern red meat industry. |

## 2.8 Stakeholder Perceptions – FWFA Resource Allocation and MER

Consultation with FWFA project stakeholders (representatives from the IAG and PLG) indicated a high level of satisfaction with project resourcing and MER.

Stakeholders interviewed indicated that they felt project resource allocation was appropriate and well managed. The MER requirements were considered adequate and not overly burdensome with good two-way communication between those involved in project activities and project management and funding partners.

The only consistent issue raised through stakeholder feedback was the opinion that future projects should place greater emphasis and resource allocation on industry engagement, extension and communication and ensure such activities are planned and integrated from the beginning of any new initiative.

Appendix 1 contains the specific details of the stakeholder feedback for the Qualitative Evaluation.

## 2.9 Final evaluation conclusions/recommendations (plans)

Plans and contracts have served the project well. The most important mid-term review recommendation, i.e., allocation of additional funds to adoption, was delivered. Final evaluation recommendations that would enhance project outcomes, knowledge of project effectiveness, and delivery of future investments include:

1. Publishing the list of extreme weather events impacting Australian agriculture 1981 to 2017 in a form that would facilitate their use by producers and their advisors.
2. Future projects should allocate resources to engagement with the supply chain/agribusiness. This sector will benefit from FWFA products and may positively influence producer adoption.
3. Collection of data on FWFA product adoption and impact as part of MLA's Business Planning and Evaluation processes. Access to this data would increase confidence in project value.

# 3. Governance arrangements for the project

The mid-term review of the FWFA project reported a high level of satisfaction with the governance of the project. The mid-term review addressed contractual arrangements, progress against budget, project management, milestone delivery, intellectual property (IP), advisory structures, and partner satisfaction with governance arrangements. Partners reported that processes and procedures were tightly managed, and that the administration of the project was not a burden. DAFF indicated that FWFA governance arrangements had been used as a model for application to other RND4P projects.

The final evaluation finds that the high standard of governance established in the first half of the project was maintained throughout the project.

## 3.1 Response to mid-term review recommendations

Seven recommendations were made in relation to governance arrangements as part of the mid-term review and these, together with the project's response, are summarised in Table 8.

Table 8: Response to Mid-term Recommendations – Governance

| Mid-term Review Recommendation | FWFA Management Response |
|---|---|
| Project management - the combined task of meeting facilitation and taking minutes is not easily managed. A project partner should be called upon to provide secretarial support to the Project Coordinator on an -in-kind basis. | Discussions held between Project Coordinator and MLA without resolution. Coordinator remained chair and note taker of the PLG. |
| IP review - the Project Coordinator should review the IP register, see if IP has been created and determine appropriate policy. The Project Coordinator should then send an updated IP Register to the project team for comment. | An IP register was created by the Project Coordinator and updated in May 2020 following the mid-term review. While the major IP for the project is the seasonal forecast products which are public good, IP needs to be agreed and recorded for project generated Risk Management Plans (6 industry specific plans + a generic plan) and this task is outstanding (gap). |
| IAG - in the second half of the project the IAG will have a key role in deciding the roll out of products, the funding of adoption and future RD&E project design. Consequently, the IAG needs to be appropriately constituted without membership overlap and meet on a regular and scheduled basis. | COVID-19 prevented regular face-to-face IAG meetings. However, the IAG has assumed a key role in reviewing recommendations from the PLG and signing off on which forecast products are advanced and finalised. Overlap between IAG and PLG has been minimised. Some joint meetings of PLG and IAG have been held when appropriate. |
| A priority for IAG consideration will be the process used to select final forecast products from each set of prototypes. The process and data employed must be agreed, documented, and communicated to each of the project partners. | A process for selecting final forecast products was documented and communicated directly to partners and more widely via FWFA newsletters. |
| The IAG should work with the Project Coordinator to prepare a Commercialisation Plan and Extension Framework for the project. | No "standalone" commercialisation plan/extension framework was prepared. However, investment in five additional extension projects, each guided by formal aims and objectives, was agreed by the IAG prior to the contracting of project partners. |

| Mid-term Review Recommendation | FWFA Management Response |
|---|---|
| IRG - in the second half of the project the IRGs will have a role in the ramp up of awareness, training, and adoption of FWFA products. It is important that these groups are functioning effectively and operating as catalysts to attract additional farmers and advisors. Strategies to encourage participation and engagement by IRG members are required. | IRGs success severely constrained by COVID-19. Regular digital meetings were scheduled to receive feedback on new experimental and operational forecast products. Sometimes, limited membership attended meetings and there was a high reliance on a few individuals. |
| Highly technical/mathematical advice – budgeted for at the project design stage, and not provided to the Project Coordinator by Professor Karoly, should be supplied from another source. | The project endeavoured unsuccessfully to find a replacement for Prof. Karoly. However, as the project progressed following the mid-term review there was less need for external technical/mathematical assistance and no replacement was ultimately appointed. |

**Recommendation 4**

IP for the six industry-specific and one generic risk management plans prepared as part of FWFA needs to be agreed and recorded in the IP register.

## 3.2 Stakeholder Perceptions – Governance

Consultation with FWFA project stakeholders (representatives from the IAG and PLG) indicated a high level of satisfaction with project governance.

As part of the stakeholder interviews, participants were asked to rate the perceived level of engagement of the IAG and/or PLG (depending on which group the participant was affiliated with) with the FWFA project's delivery? Participants were asked to use a rating scale of 1-5 with 1 being low and 5 being high perceived level of engagement.

Representatives from the IAG gave an average score of 3.0 out of 5 indicating a perceived medium level of engagement of the IAG with project delivery. Representatives from the PLG gave a higher average rating of 3.6 out of 5 indicating a perceived medium-high level of engagement of the PLG with project activities. The overall average score across all 12 respondents from both groups was 3.3 out of 5 (medium to medium-high level of engagement).

Stakeholders interviewed commented that the FWFA model, including a dedicated Project Coordinator (Russell Pattinson) alongside the IAG and PLG, was very well managed given the size and complexity of the project. Several interviewees stated that communication between project elements, facilitated by the Project Coordinator, was excellent and that they enjoyed the regular IAG/PLG meetings.

Appendix 1 contains the specific details of the stakeholder feedback for the Qualitative Evaluation.

## 3.3 Final review conclusions/recommendations (governance)

Governance arrangements have been appropriate, and standards have been maintained throughout the second half of the project. Remaining issues in relation to governance are:

4. IP for the six industry-specific and one generic risk management plans prepared as part of FWFA needs to be agreed and recorded in the IP register.

# 4. FWFA partner engagement and satisfaction

The mid-term review of the FWFA project noted that all research partners were fully engaged with the project and delivering their commitments. The major investors were also fully engaged. Where there had been staff turnover, or a minor investor was constrained for time, less was known about the project. Six industries are somewhat engaged in the project through their RDCs and IRGs. Industries making smaller commitments have opportunities to engage through the CoP and project newsletters. AgriFutures Australia expressed disappointment in not being able to secure rice grower presence in an IRG. Their $150,000 contribution was less than the $250,000 contribution made by industries with IRGs.

The final evaluation finds satisfactory partner engagement and satisfaction consistent with the first half of the project.

## 4.1 Response to mid-term review recommendations

Six recommendations were made in relation to partner engagement and satisfaction as part of the mid-term review and these, together with the project's response, are summarised in Table 9.

Table 9: Response to Mid-term Recommendations – Engagement

| Mid-term Review Recommendation | FWFA Management Response |
|---|---|
| A supplementary research project to better understand the social motivations for the use of climate information and adoption responses, compare responses across industries and learn lessons that can be used to better engage industry. The Australian Wine industry is a leader in relation to the use of climatic data and response to climate variability. Other industries lag wine industry leadership. A project in this space should be funded using interest earned on project funds subject to business case preparation. | Qualitative and quantitative market research was funded by FWFA in the second half of the project. Projects were Taylor 2021 ("Producer Requirements for Weather and Seasonal Climate Forecasting") and Kuehne 2022 ("Bridges and Barriers to Use of Seasonal Forecasts"). The outputs from these projects provided the FWFA team with insight on why forecasts are and are not being used by primary producers. |
| Consideration be given to presentation of FWFA products and project status at the next rice industry conference – of the smaller project partner industries, rice is a significant contributor to FWFA ($150,000) and is dependent on climate outlook for a crop. | Gap – while consultation was completed with AgriFutures, who manage Rice RD&E, no progress was made in presenting to rice industry conference. (NB: AgriFutures is a partner on AIA's new Agri Climate Outlook (ACO) project and there may be a future opportunity for engagement). |
| Collaboration between FWFA researchers and the Sheep CRC's commercial product Ag360 (formerly known as AskBill) be further explored including incorporation of Ag360's chill forecast data into FWFA products, the usefulness of Ag360's commercial user pays service for sustaining FWFA forecast products and the potential rollout of Ag360 to the Diary and Red Meat industries. | Gap - this opportunity was explored but little collaborative progress made. It is understood that Ag360 is driven by a different BOM forecast (5km$^2$ zones). With the wind up of the Sheep CRC, Ag360 has been transferred to UNE. |

| Mid-term Review Recommendation | FWFA Management Response |
|---|---|
| Collaboration between industry and researchers should be fostered through a mini conference at the end of the project to scope what remains to be done to have reliable forecast products used routinely by farmers and who needs to be involved to achieve this outcome. Networks should be maintained between RD&E projects with either RDC or MCV program funding to maintain the CoP and the FWFA Newsletter. DAFF has a strong interest in seeing ongoing conversations between RDCs, researchers and industry as a result of the RND4P program. | A proposed mini-conference in April 2020 was cancelled due to COVID-19. A mini conference for the end of the project was held in Melbourne in December 2022. Discussions have also been held with AIA (who have a major climate initiative) about FWFA legacy products. |
| The review team recommends that the Project Coordinator engage relevant AWI staff to capitalise on Wool Innovation's recent expression of interest in being part of the FWFA project and discuss purchase of equity, future funding, and service delivery expectations. Other RDCs, not currently participating in FWFA, should also be contacted. | AWI was contacted by the FWFA Project Coordinator but both parties agreed that the work was too far advanced to warrant change (such as establishing a wool IRG). No additional RDCs were contacted. |
| Agricultural value chain engagement is identified as being important in both the project title and objectives. Market research and a strategic plan are required to understand and engage with this and other sectors e.g., agricultural service providers, policymakers. The research and plan must ensure equity (are all banks provided with the opportunity to participate?), sufficient resources are collected to service the new partners and any expansion does not turn into a distraction. | Less engagement with the supply chain (agents, processors, etc.) than desired due to resource constraints (Final evaluation project brief). The decision not to engage supply chains was made prior to COVID-19. |

**Recommendation 5**

Ensuring the rice industry receives value from AIA – AgriFutures Australia is a member of AIA and the mid-term recommendation for rice industry engagement through their annual conference (most recently August 2022) is reiterated.

**Recommendation 6**

Realisation of opportunities around Ag360, chill indexes and Product #6 (extreme Wind) be pursued through AIA.

## 4.2 Engagement post mid-term review

Since completion of the mid-term review, there has been regular liaison between PLG members from all FWFA provider organisations. COVID-19 restrictions prevented face-to-face meetings between March 2020 and May 2022, however face-to-face meetings were substituted with monthly Zoom meetings. Zoom meetings in 2021 and 2022 focussed on work package updates, engagement with IRGs, confirmation of forecast products #3, #4 and #5, progression of risk management frameworks, and design of new extension and communication projects (Milestone 10).

IAGs met regularly through 2021 and 2022 to consider new R&D projects and which FWFA products to operationalise. The IAGs have now approved all 5 forecast products (Milestone 10).

Project collaboration since the mid-term review has included (Milestone 10):

- Collaboration with NACP Climate Mates – which provided feedback on FWFA products.
- DCAP Horticulture project – feedback on FWFA pie charts.
- Climate Services Australia Program – Future Drought Fund – used FarmLink and CSIRO input.
- Australian Climate Service – implications for natural disasters of FWFA forecast products.

**Recommendation 7**

Securing ongoing funding for the FWFA newsletter – to keep project partners, including IAG members, engaged with seasonal climate forecasting and climate risk management.

## 4.3 Stakeholder Perceptions – Engagement and Satisfaction

Consultation with FWFA project stakeholders (representatives from the IAG and PLG) indicated a medium to high level of satisfaction with partner engagement.

Stakeholders interviewed largely considered the collaboration opportunities afforded by the FWFA project to have been valuable and that, despite challenges presented by COVID-19, engagement with the IAG and PLG had been good and relatively consistent. Stakeholders also expressed satisfaction with FWFA project decision making processes including having IAG and PLG input into the decision about which BOM products to progress and how to reallocate surplus project funds.

As part of the stakeholder interviews, participants were asked to rate their perceived level of satisfaction with their organisation's involvement in the FWFA project? Participants were asked to use a rating scale of 1-5 with 1 being low and 5 being high perceived level of satisfaction for their organisation.

Representatives from the IAG gave an average score of 3.3 out of 5 indicating a perceived medium to medium-high level of satisfaction with their organisations' involvement with the FWFA project. Representatives from the PLG gave a higher average rating of 4.4 out of 5 indicating a perceived medium-high to high level of satisfaction with their organisations' involvement with the FWFA project. The overall average score across all 12 respondents from both groups was 3.8 out of 5 (medium to medium-high level of satisfaction).

Some members of the IAG expressed concern that FWFA and similar large, complex RD&E investments continue to suffer from a "free-rider" problem where various stakeholder groups do not commit balanced or equitable resources because they are able to benefit from project outputs whether they invest or not (e.g., the BOM products are publicly available on the BOM website and can be used by any industry/sector whether they were a part of the FWFA project or not).

Though the free-rider issue is not unique to the RND4P Program it should be considered for future RD&E initiatives as free-riding has a perceived negative effect on both the willingness of key stakeholders to invest in RD&E and attitudes and relationships between potential stakeholders which may constrain future collaboration.

Appendix 1 contains the specific details of the stakeholder feedback for the Qualitative Evaluation.

## 4.4 Final evaluation conclusions/recommendations (engagement)

The project has successfully engaged major investors and research partners. However, FWFA has struggled with primary industry and minor investor engagement. Some of this is due to COVID-19 lockdowns but some was apparent at the mid-term review and prior to the pandemic. Future climate research projects, including AIA's investment in Agri Climate Outlook need to do better with this difficult task. With this in mind, recommendations include:

5. Ensuring the rice industry receives value from AIA – AgriFutures Australia is a member of AIA and the mid-term recommendation for rice industry engagement through their annual conference (most recently August 2022) is reiterated.
6. Realisation of opportunities around Ag360, chill indexes and Product #6 (extreme Wind) be pursued through AIA.
7. Securing ongoing funding for the FWFA newsletter – to keep project partners, including IAG members, engaged with seasonal climate forecasting and climate risk management.

# 5. Delivery of overall objectives (outputs and outcomes)

Advice received from DAFF during the mid-term review was that the FWFA project team must focus on the future use and development of products so that their relevance doesn't diminish when the project ends. DAFF asked whether collaboration is likely to be ongoing, will users still visit relevant project websites, and will products be maintained and routinely updated? DAFF indicated that the mid-term review must comment on:

1. How the project addressed the broader RND4P Program Objectives
2. What measures are in place for continuation of the products and partnerships achieved after the project is complete. This is particularly salient with respect to Information Technology (IT) products – don't let them age and ensure they continue to be of value.

## 5.1 Response to mid-term review recommendations

Four recommendations were made in relation to delivery of objectives as part of the mid-term review and these, together with the project's response, are summarised in Table 10.

Table 10: Response to Mid-term Recommendations – Objectives and Legacy

| Mid-term Review Investment Opportunity | FWFA Management Response |
|---|---|
| Focus is now required on addressing gaps in Objective 2 i.e., engaging agribusiness value chains, mechanisms to extend project products to other industries and training of primary producers in the use of products. | Project funds were insufficient to engage agribusiness value chains. However, in the second half of the FWFA project, extension, and additional funds to support it, has been given a high priority and additional funding. |
| Five best forecast products – Project Coordinator confirm contract requirement that BOM support the five best products in perpetuity and communicate this legacy provision to the project partners. | Achieved. |
| Additional forecast products – measures are required to communicate the availability of additional product opportunities to third parties and legal arrangements need to be put in place to allow for the 'licencing' of these potential users. | Gap – no activity completed here. |
| Risk management plans – finalise these extreme event products in partnership with the RDCs and farm advisors. Risk Management Plan researchers to be focussed on how these products can be incorporated into existing RDC extension tools and programs. | Partially achieved – work on finalisation is well progressed and integration of risk management plans into RDC systems will be advanced with the relevant RDC. By mid-2022, progress had made with MLA and DA but other RDCs were less certain (SRA, GRDC, Wine Australia). As of January 2023, risk management plans have been provided to all relevant partner RDCs. |

**Recommendation 8**

Additional forecast products – investigate development and licencing opportunities for other forecast products developed as part of FWFA but not maintained by BOM.

**Recommendation 9**

Work with partner RDCs to embed risk management plans into their extension tools and programs. MLA and DA are the most advanced in this regard. Processes are also needed to ensure plans are regularly updated.

## 5.2 Delivery of RND4P objectives

Progress made in delivering RND4P program objectives in the second half of 2022 is summarised in Table 11.

Table 11: Progress Toward Realisation of RND4P Program Objectives

| RND4P objective | Progress achieved |
|---|---|
| **Objective 1:** knowledge, technologies, products, or processes that benefit primary producers. | • Five seasonal forecast products that are superior to BOMs previous offerings are now available to primary producers.<br>• A generic primary producer climate risk management plan has been developed and six industry specific risk management plans are well under way. Plans are to be made available via the RDCs. |
| **Objective 2:** Pathways to extend R&D results including understanding barriers to adoption. | • Expert social/market research has been completed to understand and address primary producer reluctance to use seasonal forecasts.<br>• New investment is underway to communicate and extend FWFA outputs to primary producers. |
| **Objective 3:** research collaborations for ongoing growth and innovation in Australian agriculture. | • FWFA has delivered strong collaborations and new working partnerships between researchers from different institutions, RDCs and some primary producers.<br>• Networks likely to persist beyond FWFA as products and strategies continue to be refined through AIA and similar initiatives. |

## 5.3 Delivery of FWFA objectives

Progress made in delivering FWFA project objectives in the second half of 2022 is summarised in Table 12.

Table 12: Progress Toward Realisation of FWFA Project Objectives

| FWFA objective | Progress achieved |
|---|---|
| **Objective 1:** identification of areas of improvement in the performance of seasonal climate forecasts. | • New climate patterns and relationships established e.g., heat extremes due to MJO.<br>• Refinement of the BOM ACCESS-S seasonal forecast modelling tool. |
| **Objective 2:** Development, trialling, and subsequent operationalisation of new BOM forecast products for extreme events in the weeks, months, and seasons ahead. | • Five new tools operationalised on the BOM website. |
| **Objective 3:** Development of risk management packages for extreme events for specific agricultural sectors, and for agriculture more generally. | • Generic risk management package complete.<br>• Six industry specific risk management packages delivered by December 2022. |

| FWFA objective | Progress achieved |
|---|---|
| **Objective 4:** Communicating the progress of the project through a variety of media platforms. | • Comprehensive communication program has been delivered spanning mainstream media (traditional and social), and industry specific publications. |

## 5.4 Final evaluation conclusions/recommendations (objectives)

FWFA has made a meaningful contribution to RND4P Program objectives and is well on the way to delivering its own project objectives. Final evaluation recommendations in relation to delivery of RND4P and project objectives include:

8. Additional forecast products – investigate development and licencing opportunities for other forecast products developed as part of FWFA but not maintained by BOM.
9. Work with partner RDCs to embed risk management plans into their extension tools and programs. MLA and DA are the most advanced in this regard. Processes are also needed to ensure plans are regularly updated.

# 6. Research gaps and investment opportunities

Future collaborative R&D to improve forecasting and primary producer response to extreme climate events will be driven by AIA's Agri Climate Outlook (ACO) program and NACP. It is understood that NACP Phase 3 will be "rolled into" AIA's ACO. Between 8 and 9 RDCs are expected to contribute to the ACO program. RDCs will not invest in AIA and another climate R&D program (this is what led to the demise of the MCV program). FWFA products will be further developed through ACO.

BOM is committed to training and engaging advisors and entities to use FWFA products post project completion. Also, as of January 2023, MLA and the South NSW Drought Hub had commissioned Pinion Advisory[3] to develop a "train the trainer" program (producers and advisors) for the five new forecast products. The program will be rolled out from April to May 2023 and will conclude in June 2023.

The Australian Government's Future Drought Fund, Drought Hubs and the Climate Service for Agriculture Initiative may also be relevant to further adoption of FWFA products (UoM extension proposal). Specific research gaps were identified at the FWFA mini conference held in December 2022. This chapter serves as a summary, documenting ideas collected through both the mid-term and final FWFA evaluations.

## 6.1 Research and adoption gaps at mid-term review

Nine recommendations were made in relation to research gaps as part of the mid-term review and these, together with the project's response, are summarised in Table 13.

Table 13: Research Gaps/Investment Opportunities at Mid-term Review

| Mid-term Review Investment Opportunity | FWFA Management Response |
|---|---|
| Addressing inconsistency between the 7-day forecast and ACCESS-S products. | Gap. Has been the subject of much discussion. The issue is well known but has proved to be a complex technical problem and further development work post FWFA will be required. It will be a major focus of the AIA ACO. |
| Understanding how different industries respond to climate information (wine leads, others lag). | Investment made including "Producer requirements for weather and seasonal climate forecasting" and "Bridges and Barriers to Use of Seasonal Forecasts" project to understand social issues associated with adoption. |
| Completing primary producer climate literacy research (e.g., understanding deciles and quartiles). | No research completed on literacy. However, the FWFA project understands that this is low and has addressed the issue through current and planned extension activities. Also, a major focus for NACP. |
| Understanding social response by primary producers to extreme events (e.g., depression and policy responses needed). | Gap – this research has not been completed. |
| Extending FWFA forecast products from 6 to 18 months into the future | Gap – may be pursued as part of future investments including AIA's investment ACO. |

[3] See: https://www.pinionadvisory.com/

| Mid-term Review Investment Opportunity | FWFA Management Response |
|---|---|
| Producing Industry and Location Specific Forecasts and Products | Location specific forecasts a key element of the 5 new forecast products. Industry specific forecast not fully addressed although the 3-day burst product is primarily focussed on northern red meat industry. Industry specific may be pursued as part of future investments including AIA's ACO. |
| Developing FWFA Set#6 (Extreme Wind) Events | Gap – Discussed with BOM. Wind is inherently difficult to forecast. Some consideration in heat load index project. May be pursued as part of future investments including AIA's ACO. |
| FWFA Project Coordinator should continue to document project adoption successes, such as the Sudden Stratospheric Warming (SSW) forecast. | UM extension project is collating all extension activities conducted by project partners. BCG developing case studies on product use. Will also be the focus of videos. NACP project might also provide useful information on adoption of seasonal forecasts (but only for northern red meat industry). |
| The review recommends a mini conference at project's end to review what has been achieved and what remains to be done to have farmers routinely using unique forecasts. The mini conference may scope new collaborative investments. | A mini conference was held at the end of the project in December 2022. |

## 6.2 Stakeholder Perceptions – RD&E Gaps

Consultation with FWFA project stakeholders (representatives from the IAG and PLG) revealed the following topics that were perceived as potential RD&E gaps that could be addressed with further investment:

Perceived R&D Gaps:

- Measuring adoption and value of the FWFA five BOM products to producers including how they are engaging with the products and how they are using the products in practical decision making on-farm. (Note: partially addressed by the existing FWFA Quantitative Evaluation. See also Recommendation 3)
- Improved forecast accuracy and increased understanding of the drivers that interact and affect climate extremes at different times (e.g., compounding factors and events such as extreme evaporation, wind effect on heat forecasts etc.).
- Improved longer range forecasting, particularly for heat.
- Customise and formalise risk management packages for all sectors.

Perceived Extension/ Adoption Activity Gaps:

- Engaging with people/organisations that already are trusted sources of climate information to extend the FWFA project outputs (e.g., advisors, consultants, etc.)
- Education to increase industry capacity to understand, interpret, and apply FWFA products and other climate tools.

- Extension of FWFA outputs through linkages with sideline industry events (e.g., MLA's Beef Week etc.,)
- Industry specific extension that demonstrates how the BOM products can be used in practice for on-farm decision making.

Appendix 1 contains the specific details of the stakeholder feedback for the Qualitative Evaluation.

## 6.3 Opportunities for future climate extreme RD&E

Opportunities for future collaborative climate extreme and other related climate area RD&E identified during the final FWFA evaluation include:

- Further training of primary producer advisors and train-the-trainer initiatives in the use of FWFA products (noting the commission of Pinion Advisory to complete a "train the trainer" program from April to June 2023).
- Address the inconsistency between the 7-day forecast and ACCESS-S2 products.
- Increase the accuracy of seasonal forecasts. At current time "not accurate enough to rely on but too good to ignore".
- Extension of FWFA products from 6 months into the future to 12 months or more.
- Develop industry and location specific extreme event forecasts.
- Produce Product #6 (Extreme Wind) which incorporates a Chill Index, potentially adding to the Ag360 product.
- Engage the agribusiness/supply chain, not done this time due to funding shortfall and there is opportunity to both benefit this sector and to use this sector to encourage producer adoption.
- Further exploration of private investment in the development of tailored forecast products – e.g., products for individual entities like Jane's Weather.
- Further development of risk management plans including their automation as software (current Uni of Adelaide project) and ongoing update of their content post FWFA.
- Research to understanding social response by primary producers to extreme events (e.g., depression and policy responses needed).

# 7. Conclusions and recommendations

## 7.1 Conclusions from the final review

The independent final review concluded that the FWFA RND4P project has been a valuable, relevant, effective, and efficient RD&E project. FWFA directly addressed each of the RND4P Program objectives and represents a practical response for the agricultural sector to better understand and adapt to a variable climate.

The project was undertaken in a manner consistent with relevant plans and contracts and delivered against all project objectives. Governance arrangements were strong throughout the project and stakeholders indicated a high level of satisfaction with project governance and management. FWFA partners were largely engaged and satisfied with project progress and adaptability, particularly with respect to project management during the COVID-19 global pandemic.

Overall, the project was well designed and executed with few research gaps. The FWFA project has been presented by stakeholders as a best practice example of a large and complex collaborative R&D project.

## 7.2 Recommendations from the final review

The independent final review of the FWFA project led to the following recommendations:

**Plans:**

1. Publishing the list of extreme weather events impacting Australian agriculture 1981 to 2017 in a form that would facilitate their use by producers and their advisors.
2. Future projects should allocate resources to engagement with the supply chain/agribusiness. This sector will benefit from FWFA products and may positively influence producer adoption.
3. Collection of data on FWFA product adoption and impact as part of MLA's Business Planning and Evaluation processes. Access to this data would increase confidence in project value.

**Governance:**

4. IP for the six industry-specific and one generic risk management plans prepared as part of FWFA needs to be agreed and recorded in the IP register.

**Engagement:**

5. Ensuring the rice industry receives value from AIA – AgriFutures Australia is a member of AIA and the mid-term recommendation for rice industry engagement through their annual conference (most recently August 2022) is reiterated.
6. Realisation of opportunities around Ag360, chill indexes and Product #6 (extreme Wind) be pursued through AIA.
7. Securing ongoing funding for the FWFA newsletter – to keep project partners, including IAG members, engaged with seasonal climate forecasting and climate risk management.

**Objectives:**

8. Additional forecast products – investigate development and licencing opportunities for other forecast products developed as part of FWFA but not maintained by BOM.
9. Work with partner RDCs to embed risk management plans into their extension tools and programs. MLA and DA are the most advanced in this regard. Processes are also needed to ensure plans are regularly updated.

## 7.3 Future collaborative R&D opportunities: summary

Based on the independent final review of FWFA and associated stakeholder insights, the following areas were identified as opportunities for future collaborative climate extreme and other related climate area RD&E:

- Further training of primary producer advisors and train-the-trainer initiatives in the use of FWFA products (noting the commission of Pinion Advisory to complete a “train the trainer” program from April to June 2023).
- Address the inconsistency between the 7-day forecast and ACCESS-S2 products.
- Increase the accuracy of seasonal forecasts. At current time “not accurate enough to rely on but too good to ignore”.
- Extension of FWFA products from 6 months into the future to 12 months or more.
- Develop industry and location specific extreme event forecasts.
- Produce Product #6 (Extreme Wind) which incorporates a Chill Index, potentially adding to the Ag360 product.
- Engage the agribusiness/supply chain, not done this time due to funding shortfall and there is opportunity to both benefit this sector and to use this sector to encourage producer adoption.
- Further exploration of private investment in the development of tailored forecast products – e.g., products for individual entities like Jane’s Weather.
- Further development of risk management plans including their automation as software (current UoM project) and ongoing update of their content post FWFA.
- Research to understanding social response by primary producers to extreme events (e.g., depression and policy responses needed).

# References

Clarke, M., & Alford, A. (2020). *Mid-term Review of the Forewarned is Forearmed Project: equipping farmers and agricultural value chains to proactively manage the impacts of extreme climate events.* Syndey, NSW: unpublished client report.

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Taylor, K. Quantum Research. (2021). *Producer Requirements for Weather and Seasonal Climate Forecasting.* Sydney, NSW: Meat & Livestock Australia. Retrieved from https://www.climatekelpie.com.au/index.php/producer-requirements-for-weather-seasonal-climate-forecasting/

The Centre for International Economics. (2014). *Analysis of the benefits of improved seasonal climate forecasting - For sectors outside agriculture.* Canberra, ACT: Managing Climate Variability R&D Program.

# Appendices

## Appendix 1: Stakeholder consultation

The following sections describe the stakeholder consultation process and findings from the FWFA final evaluation for the Qualitative Evaluation.

## Consultation Process

A list of IAG and PLG representatives with their contact details was provided to the evaluation team by MLA. Each representative identified was contacted first by email seeking their participation in a one-on-one interview to provide input and insights to the FWFA final evaluation.

The one-on-one interviews were conducted online using Microsoft Teams videoconferencing or similar software between September and December 2022. The interviews were semi-structured, guided by a 21 question survey/questionnaire to ensure that responses were consistent with the consultation conducted as part of the FWFA mid-term review.

Interviews took between 30 minutes and 1 hour. Interviews were confidential to provide participants with the confidence to present honest and genuine feedback. Participants' responses were recorded anonymously, and the findings reported to support the FWFA project final evaluation.

## Stakeholder Questionnaire

The following questions were developed to guide the stakeholder interviews with IAG and PLG representatives:

**Introduction**

MLA has appointed Talia Hardaker (ACRE Economics Pty Ltd) and Michael Clarke (AgEconPlus Pty Ltd) to undertake a Final Evaluation of the Forewarned is Forearmed (FWFA) Rural R&D for Profit project. Your assistance with the following review related questions will be of value to both the final evaluation and the legacy of the FWFA project.

**About You**

1. Name and organisation and role/position please?
2. What was your role in the FWFA project?
3. How would you rate your level of engagement and familiarity with the FWFA project (1-5)?
   1 – low  2 – medium-low  3 – medium  4 – medium-high  5 – high

**Project Investment**

4. In your opinion, was the allocation of financial resources within the project appropriate?
5. If no, what could have been improved/where could resources have been allocated differently to improve project outcomes?

**Governance Arrangements**

6. Are there any issues you would like to raise in relation to project governance?
7. Were enough resources applied to project management (too few/many)?
8. How would you rate the level of engagement of the Investor Advisory Group (IAG) with the FWFA project's delivery?
   1 – low  2 – medium-low  3 – medium  4 – medium-high  5 – high

**Partner Engagement**

9. From your perspective, were any of the FWFA partners not engaged/delivering commitments?
10. What structures or processes could be put in place to improve partner engagement in future climate RD&E similar to FWFA?

11. Were your organisation's needs met by the project and the project management team?
12. How would you rate the level of satisfaction with your/your organisation's involvement in the FWFA project?
    1 – low  2 – medium-low  3 – medium  4 – medium-high  5 – high

**MER**

13. From your perspective, were FWFA project monitoring, evaluation, and reporting processes adequate and appropriate?

**Gaps in R&D and Adoption Activities**

14. Were there any gaps in the FWFA research program that still need to be addressed, please describe?
15. Was there duplication and/or too much overlap between FWFA and other parallel climate research (NACP, DCAP, Ag360)?
16. The FWFA project was able to allocate unused project funds to enable additional extension/adoption activities. In your opinion, are current adoption/extension activities adequate and appropriate?
17. Are there other gaps in adoption activities, please describe?

**Recommendations**

18. What recommendations would you make to enhance the chances of project success for future climate research similar to FWFA?
19. What mechanisms and metrics should be put in place to objectively monitor and measure success post-2022 (e.g., adoption use numbers for FWFA BOM products, valuation of mitigation of an extreme weather event, capacity build by the project)?
20. In your experience, have you found the program to be adaptable and able to accommodate opportunities as they arose, any examples?

**Other**

21. Any other issues you would like to raise or feedback you would like to provide (positive or negative) regarding the FWFA project?

## Results

A total of 14 individuals were interviewed (45% response rate at an individual level) representing 12 FWFA stakeholder organisations (66.7% response rate at an organisational level). There were 8 IAG representatives (57 % IAG response rate), 6 PLG representatives (37.5% PLG response rate), plus general consultation with the Project Coordinator (Russell Pattinson) and MLA Project Manager (Michelle Ford, also a representative on the IAG and PLG). In one case, three individuals from one organisation participated in the interview and recorded a single, organisation level response to each of the interview questions. Thus, a total of 12 interview responses were recorded for the stakeholder consultation process.

## Appendix 2: Record of documents reviewed

The independent final evaluation of the FWFA project involved a detailed literature review of project documents and other information. Table X below provides a record of all documentation reviewed throughout the evaluation.

Table 14: Record of documentation reviewed for the FWFA independent final evaluation

| No. | Document title | Type |
|---|---|---|
| 1 | 200414 AgEconPlus Mid-term Review FWFA Final Report | DOCX |
| 2 | MLA Evaluation Framework Guide (Detailed) - Internal | DOCX |
| 3 | j12641 FWFA impact methodology notes | DOCX |
| 4 | fwfa-tor-for-final-review-final | DOCX |
| 5 | 220805 FWFA Final Evaluation - Contact List | DOCX |
| 6 | Attachment 6 SARDI Generic risk management plans | DOCX |
| 7 | FWFA_Conference report_DRAFT | DOCX |
| 8 | FWFA-stats-20220920 | DOCX |
| 9 | SARDI FWFA M1011 Attachment 5 A framework to explore climate risky decision Hayman and Mudge | DOCX |
| 10 | SARDI M3 Methods to analyse the risk and returns of climatically sensitive decisions_ | DOCX |
| 11 | FWFA Newsletter 2 Final | DOCX |
| 12 | Links to FWFA information | DOCX |
| 13 | 220729 Goat Fibre Extension and Snapshot Consultation Paper | DOCX |
| 14 | FWFA IP Register v2 | DOCX |
| 15 | Appendix 1 FWFA Milestone 10 Communication and Extension activities | DOCX |
| 16 | MLA RnD4Profit -16-03-007 MLA FWFA- Milestone report 8 Final | DOCX |
| 17 | MLA RnD4Profit 16-03-007 MLA FWFA Milestone Report 2 Final | DOCX |
| 18 | MLA RnD4Profit 16-03-007 MLA FWFA Milestone Report 3 v2 | DOCX |
| 19 | MLA RnD4Profit 16-03-007 MLA FWFA Milestone Report 4 | DOCX |
| 20 | MLA RnD4Profit 16-03-007 MLA FWFA Milestone Report 5 | DOCX |
| 21 | MLA RnD4Profit 16-03-007 MLA FWFA Milestone Report 6 | DOCX |
| 22 | MLA RnD4Profit 16-03-007 MLA FWFA Milestone Report 7 -30 April 2020 | DOCX |
| 23 | MLA Rnd4Profit-16-03-007 FWFA MILESTONE 9 REPORT 30 April 2021_final | DOCX |
| 24 | Rnd4Profit-16-03-007 FWFA MILESTONE 10 REPORT 15 May 2022 final | DOCX |
| 25 | P.PSH.0951 Milestone 9 Report | DOCX |
| 26 | p00443 NACP Product Evaluation 2021 | DOCX |
| 27 | 1.1 FWFA RDE proposal HLI Business Case 22092021 | DOCX |
| 28 | 4. SARDI FWFA RDE proposal Interactive Decision Analysis | DOCX |
| 29 | Ideas for FWFA mark 2 | DOCX |
| 30 | IAG Meeting Draft Minutes August 2021 | DOCX |
| 31 | IAG Meeting Draft Minutes December 2021 | DOCX |
| 32 | IAG Meeting Draft Minutes February 2022 | DOCX |
| 33 | IAG Meeting Draft Minutes June 2021 | DOCX |
| 34 | IAG Meeting Draft Minutes November 2021 | DOCX |
| 35 | IAG Meeting March 2020 Draft Minutes | DOCX |
| 36 | IAG Meeting March 2021 Draft Minutes | DOCX |

| No. | Document title | Type |
|---|---|---|
| 37 | IAG Meeting October 2020 Draft Minutes | DOCX |
| 38 | PLG & IAG Draft Minutes February 2021 | DOCX |
| 39 | PLG 10 Draft Minutes March 2020 | DOCX |
| 40 | PLG 11 Draft Minutes May 2020 | DOCX |
| 41 | PLG 12 Draft Minutes July 2020 | DOCX |
| 42 | PLG 13 Draft Minutes | DOCX |
| 43 | PLG 13.5 Draft Minutes October 2020 | DOCX |
| 44 | PLG 15 Draft Minutes | DOCX |
| 45 | PLG 16 Draft Minutes April 2021 | DOCX |
| 46 | PLG 17 Draft Minutes May 2021 | DOCX |
| 47 | PLG 18 Draft Minutes June 2021 | DOCX |
| 48 | PLG 19 Draft Minutes July 2021 | DOCX |
| 49 | PLG 20 Draft Minutes Sept 2021 | DOCX |
| 50 | PLG 21 Draft Minutes Nov 2021 | DOCX |
| 51 | PLG 22 Draft Minutes February 2022 | DOCX |
| 52 | PLG 23 Draft Minutes April 2022 | DOCX |
| 53 | PLG 24 Draft Minutes June 2022 | DOCX |
| 54 | PLG 25 Draft Minutes July 2022 | DOCX |
| 55 | Draft agenda 4 | DOCX |
| 56 | Finasl draft agenda | DOCX |
| 57 | 220808 Response to Mid-term Review DRAFT_rdp | DOCX |
| 58 | Laundry Lane - Meat and Livestock proposal | PDF |
| 59 | UoM FWFA Proposal_Communications and Extension FINAL | PDF |
| 60 | CVA002 Fin rep | PDF |
| 61 | economic-analysis-climate-proofing-projects | PDF |
| 62 | MCV-CIE-report-Value-of-improved-forecasts-non-agriculture-2014 | PDF |
| 63 | MCV-CIE-report-Value-of-improved-forecasts-agriculture-2014 (1) | PDF |
| 64 | Northern Australia Climate Project Phase 1 | PDF |
| 65 | mla-evaluation-framework-guide-summary-final | PDF |
| 66 | MLA Extension Program Data Collection MER Framework | PDF |
| 67 | RRD4P_Improved Use of Seasonal Forecasting (AgriFutures) | PDF |
| 68 | 6313_mudgeb | PDF |
| 69 | FWFA-BoM-WP1-User-Needs-Synthesis-Report | PDF |
| 70 | FWFA Newsletter 1 August 2018 Final | PDF |
| 71 | FWFA Newsletter 3 Final | PDF |
| 72 | FWFA Newsletter 4 Final June 2021 | PDF |
| 73 | FWFA Newsletter 5 February 2022 | PDF |
| 74 | FWFA Newsletter May 2019 Final | PDF |
| 75 | IPandBoMData | PDF |
| 76 | b.cch.2119-final-report Quantum market research | PDF |
| 77 | B.CCH.2122 Final Report | PDF |
| 78 | UoM_FWFA Milestone Report 11 Final | PDF |
| 79 | 3. UoM FWFA Proposal_Communications and Extension FINAL | PDF |

| No. | Document title | Type |
|---|---|---|
| 80 | FWFA Final Evaluation IAG-PLG Stakeholder Questionnaire | PDF |
| 81 | 221117 FWFA Final Evaluation - Introduction for Stakeholder Consultation V2 | PDF |
| 82 | FWFA_Video Proposal | PPT |
| 83 | Climate Kelpie_Produce Requirements_files | WEB |
| 84 | Extremes Budget Detailed | XLSX |
| 85 | FWFA PROJECT experimental product feedback | XLSX |
| 86 | Mailing list for RP 09112022 | XLSX |