More Profit from Nitrogen

Final Evaluation

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Ag Econ

More Profit from Nitrogen Final Evaluation

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Summary

About the MPfN program

The More Profit from Nitrogen (MPfN) program was a partnership between the agriculture industry's four major intensive users of nitrogenous fertilisers— dairy, sugar, cotton, and horticulture (mango and cherry). The MPfN was funded through the Department of Agriculture, Water and the Environment's Rural R&D for Profit program.

The MPfN was established with an aim to bring about increased farm profitability and reduced environmental impact by increasing nitrogen use efficiency (NUE) across the four participating industries, as measured by a reduction in the amount of applied N required to produce each unit of product. This was to be achieved through research into three areas:

- How enhanced EEF formulations can better match a crop's or pasture's specific N requirements (Activity B4—Extracting value from enhanced efficiency fertilisers).
- The interplay of soil, weather, climatic and farm management factors to optimise nitrogen N formulation, rate and timing across industries, farming regions, as well as irrigated and non-irrigated situations (Activity B5—Optimising NUE in irrigated systems).
- The contribution (quantifying rate and timing) of mineralisation to a crop or pasture's N budget (Activity B6—Better understanding N supply through mineralisation)

The MPfN commenced in July 2016 and will conclude in September 2021.

About the MPfN Final Evaluation

Ag Econ was engaged by the Cotton Research and Development Corporation (CRDC), the MPfN program manager, to complete a Final Evaluation of the MPfN program.

The Evaluation focused on three components:

- Delivery against the MPfN plans
- Delivery against the MPfN objectives
- The immediate and legacy impact upon nitrogen practices to improve NUE across the sugar, dairy, cotton, mango and cherry industries.

The Evaluation was based on a combination of document review, and feedback from 69 MPfN stakeholders. Stakeholders completed an online survey where they rated and provided comments on the MPfN delivery and outcomes. Follow-up telephone interviews were conducted with 38 stakeholders to gain additional feedback.

Summary of evaluation findings

The delivery of the MPfN program was assessed to be strong against the three evaluation components.

Part 1. Evaluation of delivery against MPfN plans

The whole-of-program activities and deliverables were evaluated against the outputs, milestones and performance indicators of the three MPfN plans:

- The Program Management Plan (PMP)
- The Communication and extension Plan (CEP)
- The Monitoring and Evaluation Plan (MEP).

Stakeholder feedback on program delivery was also captured, including for the program planning, reporting, and internal communications.

The delivery of MPfN activities and outputs against the three MPfN Plans was evaluated as strong overall. Across the three plans, an average 91% of planned outputs, milestones and performance indicators were evaluated as strongly delivered (Table 1).

Table 1. Summary of evaluation of program delivery against the MPfN plans

MPfN plan	Elements rated as strong	Overall evaluation
Overall evaluation of delivery against the MPfN PMP	132/133 (99%)	Strong
Overall evaluation of delivery against the MPfN CEP	22/24 (92%)	Strong
Overall evaluation of delivery against the MPfN MEP	35/42 (83%)	Strong
Overall stakeholder rating of planning, monitoring and reporting	4.2 (n=34)	Strong
Overall evaluation of delivery against the MPfN plans (average rating)	**91%**	**Strong**

The MPfN delivered more than 150% of planned activities and outputs across collaboration, communication, and extension. Internal stakeholders rated the project planning, monitoring and delivery as highly effective (average 4.2, n=34), and the administrative support provided as highly effective (average 4.2, n=26), with generally positive comments supporting these ratings.

Part 2. Evaluation of delivery against program objectives

Building on the evaluation of delivery against the MPfN plans, stakeholder ratings and comments were used to evaluate program delivery against the MPfN primary and secondary objectives.

Primary objectives:

- Generate greater knowledge and understanding of the factors that influence NUE.
- Identify new NUE strategies and technologies, or update or validate existing NUE strategies and technologies to inform NUE resources across the four industries.

Secondary objectives:

- Support the establishment and fostering of industry and research collaborations that form the basis for ongoing innovation and growth of Australian agriculture.
- Support strengthened pathways to extend the results of rural R&D, including understanding the barriers to adoption.

Overall, delivery of the MPfN against the three program objectives was evaluated as strong (Table 2).

Table 2. Summary of evaluation of program delivery against the MPfN objectives

Evaluation of successful delivery against the project objectives		Average stakeholder rating	Overall evaluation
Primary objectives	Generate knowledge and understanding	3.9 (n=62)	Strong
	Inform NUE resources	3.6 (n=60)	Moderate
Secondary objectives	Support collaboration (internal stakeholders only)	4.0 (n=33)	Strong
	Support extension pathways	3.6 (n=61)	Moderate
Overall evaluation of delivery against the MPfN objectives (average rating)		**3.8**	**Strong**

Across the MPfN objectives, the perceived effectiveness against research level outcomes (research level knowledge and fostering collaboration) was strong, reflecting the delivery of a high level of research outcomes for what was fundamentally a research program. While the perceived effectiveness against industry level outcomes (contribution to industry level resources, extension, and changes in industry level knowledge) was moderate, the lower ratings were consistent with these primarily being secondary objectives of the program. In particular, comments recognised that while the MPfN delivered clear R&D outputs to inform industry resources (a primary MPfN objective), responsibility

for integrating the findings into industry resources and extending these to growers lay primarily with the individual industries and would continue beyond the completion of the MPfN. In addition, while all industries had begun to integrate the MPfN recommendations into industry resources, or had plans to do so, the comments indicated that service providers and producers were not as aware of this ongoing process, which likely contributed to their lower ratings in this area.

Part 3. Evaluation of immediate and legacy impact

Stakeholders rated producer confidence to adopt as moderate; however, it is important to note that the timeframe for practice change within an agricultural R&D context can take years (or decades). It is rare for industry adoption of R&D to occur rapidly following the completion of the underlying research, but rather, adoption occurs in stages depending on the overlapping of a range of underlying factors including the strength of extension pathways and stakeholders' appetite for risk and change (social aspects), and underlying market conditions relating to the commodity and the innovation (economic aspects). A wide range of social and economic barriers were identified by MPfN stakeholders, with the primary impediments being the perceived risk of missing out on lost productivity with reduced N application, combined with the low cost of traditional N sources such as urea. Together, these factors support a culture where N is applied as a form of cheap insurance to maximise productivity.

The identified social and economic factors present potential barriers to practice change, reducing the rate or level of overall adoption of new practices and technologies. Understanding and addressing these barriers to change where possible, and reinforcing the key research messages through industry specific resources and extension becomes critical to achieving incremental practice change and industry impact. While this process can be supported with communication and extension throughout the R&D process (as the MPfN has done through the delivery of 150% of planned communication and extension activities and outputs), it's success is ultimately dependent on extension of the final research results in the longer term following the completion of the research phase, with this responsibility falling to the industry research organisations and supporting industry bodies. Importantly, the significance of this ongoing process was clearly recognised by research level stakeholders through their feedback, and across all stakeholders adoption was considered likely to occur over time as the MPfN recommendations are integrated into industry resources and extension programs. Promisingly, stakeholders commented that adoption was already evident in all industries, with demonstrated potential for economic and environmental benefits including yield or quality improvements, reduced N inputs, and reduced losses of N to the environment.

Considering the above, the MPfN's 1) strong contribution to generating knowledge and understanding; 2) identification of NUE strategies or technologies that were made available for inclusion (and in some cases already included) in industry NUE resources; and 3) contribution to a moderate (borderline high) industry confidence to adopt the NUE strategies, are together assessed to generate a strong immediate research impact, and a strong foundation supporting potential future adoption of NUE practices resulting in improved profitability and reduced environmental impact (Table 3). Importantly, it is up to individual industry research and extension bodies to convert this potential into realised NUE practice change and industry impact by continuing the process of integrating the MPfN recommendations into industry resources and extension programs, and understanding and addressing industry specific barriers to NUE practice change.

Table 3. Summary of evaluation of immediate and legacy impact to improve on-farm NUE

Evaluation of immediate and legacy impact to improve on-farm NUE	**Average stakeholder rating**	**Overall evaluation**
Generate knowledge (from *Part 2*)	3.9 (n=62)	Strong
Inform NUE resources (from *Part 2*)	3.6 (n=60)	Moderate
Confidence to adopt MPfN strategies and recommendations	3.7 (n=65)	Moderate
Overall evaluation of immediate and legacy impact (average rating)	**3.7**	**Strong**

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Introduction

About the program

The More Profit from Nitrogen Program (MPfN) program was a partnership between the agriculture industry's four major intensive users of nitrogenous fertilisers— dairy, sugar, cotton, and horticulture (mango and cherry).

The MPfN program was led by the Cotton Research and Development Corporation (CRDC) in partnerships with Dairy Australia, Sugar Research Australia, and Hort Innovation. The MPfN received funding through the Department of Agriculture, Water and the Environment's Rural R&D for Profit (RRD4P) program, each of the participating RDCs, and the research organisations responsible for project delivery.

The objective of RRD4P was to realise productivity and profitability improvements for primary producers. In support of this, MPfN was established to bring about increased farm profitability and reduced environmental impact by increasing nitrogen use efficiency (NUE) across the four industry sectors, measured by a reduction in the amount of applied nitrogen (N) required to produce each unit of product.

The Commonwealth Grant Agreement (CGA) committed the MPfN to focus on three key areas of research:

- How enhanced EEF formulations can better match a crop or pasture's specific N requirements (Activity B4—Extracting value from enhanced efficiency fertilisers).
- The interplay of soil, weather, climatic and farm management factors to optimise nitrogen N formulation, rate and timing across industries, farming regions, as well as irrigated and non-irrigated situations (Activity B5—Optimising NUE in irrigated systems).
- The contribution (quantifying rate and timing) of mineralisation to a crop or pasture's N budget (Activity B6—Better understanding N supply through mineralisation)

Through this research focus, as well as supporting collaboration, communication and extension activities and outputs, the MPfN delivered against its primary and secondary objectives, which align with the RRD4P objectives:

Primary objectives:

- Generate greater knowledge and understanding of the factors that influence NUE across the four industries.
- Identify new NUE strategies and technologies, or update or validate existing NUE strategies and technologies to inform NUE resources across the four industries.

Secondary objectives:

- Support the establishment and fostering of industry and research collaborations that form the basis for ongoing innovation and growth of Australian agriculture.
- Support strengthened pathways to extend the results of rural R&D, including understanding the barriers to adoption.

The MPfN Program commenced in July 2016 and will conclude in September 2021.

Under the umbrella of MPfN, ten sub-projects, consisting of a mix of field, laboratory and modelling based studies were established. An additional small cross-program project was also contracted on May 2019, focussing on standardising NUE language and metrics across the industries involved. The eleven projects and project delivery partners are listed in *Appendix A*.

About the evaluation

Ag Econ was engaged by the CRDC to undertake an independent final evaluation of the MPfN program. The evaluation scope was informed by the *Final Evaluation & Economic Case Study Consultant Terms of Reference* (TOR) and discussions with the MPfN Science Coordinator and the CRDC Program Manager.

The report is laid out in three parts to reflect this scope.

Part 1. Evaluate program delivery against MPfN plans:

- Assess whole-of-program activities and deliverables against the Project Management Plan (PMP), Communication and Extension Plan (CEP), Monitoring and Evaluation Plan (MEP), and the Mid-term evaluation report.

Part 2. Evaluate program delivery against MPfN objectives:

- Assess the extent to which the MPfN Program has achieved its primary objectives to increase NUE knowledge and understanding, and inform new or updated industry NUE resources; and its secondary objectives to support collaboration, and support extension pathways.

Part 3. Evaluate immediate and legacy impact upon industry nitrogen management practices to improve on-farm NUE:

- Assess the extent to which the MPfN activities have resulted, or will over time result in greater confidence to adopt the NUE strategies and recommendations.
- Assess the extent to which potential adoption of the NUE strategies and recommendations will result in increased profitability and reduced environmental impact.

Evaluation Method

The evaluation methodology was informed by the TOR in conjunction with the MEP, the PMP, the CEP, and the findings from the Mid-Term Evaluation report.

Two stage approach

The evaluation was undertaken in two defined stages in 2020 (Stage 1) and 2021 (Stage 2). The staged approach was designed to evaluate underlying projects at a similar time in relation to their completion date. The projects included in each stage are in *Appendix A*.

Seven key evaluation questions (KEQs) were provided in the TOR which relate to MPfN program delivery and outcomes. The KEQs and their alignment to the project scope are shown in *Appendix B*.

The KEQs were evaluated based on a combination of surveys and interviews with internal and external stakeholders, and a review of project and program documentation.

Stakeholder surveys and interviews

A register of 69 stakeholders was confirmed through the research project leads and the MPfN Science Coordinator. *Appendix C* shows the breakdown of the 69 stakeholders engaged for the final evaluation by stakeholder type, project, and industry.

The seven KEQs were aligned to appropriate survey and interview questions based on the Mid-Term Evaluation (where appropriate, to provide consistency and continuity), as well as the Performance Indicators from the Program Logic Framework in the MEP.

Through an online survey and follow up interviews, the stakeholders answered questions that included a mixture of quantitative ratings using a Likert scale (asking respondents to provide a rated response of 1 (lowest) to 5 (highest)), supported by open-ended qualitative questions to provide detail and context. The full list of survey and interview questions are identified in *Appendix D*.

The stakeholder quantitative ratings were presented as an average of the stakeholder groups. Where appropriate, the quantitative findings of the Final Evaluation were compared to the findings of the Mid-Term Evaluation to gain an understanding of changes in stakeholder perceptions[1].

The results of the qualitative responses were summarised using a thematic analysis template. The qualitative responses were broken into key themes with the number of responses and the proportion of stakeholders responding for each industry, and a sample quote provided.

Some stakeholders were part of multiple projects and industries, so stakeholder totals presented in qualitative and quantitative summary tables do not equal the sum of underlying industry stakeholders.

Document review

A list of relevant program and project level documentation was identified through the TOR and in discussion with the MPfN Science Coordinator. The document register is in *Appendix E*.

Evaluation criteria

To evaluate the whole-of-program activities and deliverables against the MPfN Plans and objectives a three-level traffic light system was used.

For the document review the evaluation status was determined as shown in Table 1.

Table 1. Output evaluation criteria

Evaluation Status	Evaluation criteria
Strong	Delivery of outputs against planned criteria in full or with minor omissions or gaps
Moderate	Partial delivery of outputs against planned criteria, with moderate omissions or gaps
Weak	Limited delivery of outputs against planned criteria, with significant omissions or gaps

For the stakeholder quantitative ratings the evaluation status was determined as shown in Table 2.

Table 2. Stakeholder quantitative response ratings

Stakeholder rating	Evaluation criteria
Strong	Rating of between 3.68 to 5
Moderate	Rating of between 2.34 to 3.67
Weak	Rating of between 1 to 2.33

In some instances, a combined approach was required, including both output review and stakeholder feedback. In these instances, the stakeholder criteria (Table 1) and activity and output criteria (Table 2) were combined as shown in Table 3.

Table 3. Combined evaluation criteria

		Stakeholder response evaluation status		
		Strong	Moderate	Weak
Document review evaluation status	Strong	Strong	Strong	Moderate
	Moderate	Strong	Moderate	Weak
	Weak	Moderate	Weak	Weak

[1] The MEP noted that when reporting on changes in knowledge, understanding, and resources relating to NUE, the Mid-Term and Final Evaluation should report against the baseline data report. No baseline data report was completed so the Final Evaluation has used the Mid-Term Evaluation as a baseline for comparison where appropriate.

PART 1: EVALUATION OF DELIVERY AGAINST MPFN PLANS

This section evaluates the whole-of-program activities and deliverables against the outputs, milestones and performance indicators of the three MPfN plans:

- The Program Management Plan (PMP)
- The Communication and extension Plan (CEP)
- The Monitoring and Evaluation Plan (MEP).

Stakeholder feedback on program delivery was also captured, including for the program planning, reporting, and internal communications.

Delivery against the MPfN Program Management Plan

The PMP was completed in Feb 2017, in line with Activity B2, output 2(a) of the CGA. A Deed of Variation (DoV) to the CGA was developed on 24 August 2017 and ratified on 01 December 2017, which included some adjustment of dates and addition of KPIs throughout the MPfN program. The executed DoV was subsequently used as an ongoing supporting document to the PMP.

Through a review of MPfN documentation, delivery of the MPfN program against the PMP was evaluated as strong (Table 4). All activities were successfully completed according to the DOV, with the exception of activity B4 where one KPI was partially achieved and carried through to the following milestone. A full list of the MPfN activities, outputs, KPIs, and milestones making up the DoV are shown in *Appendix F*, including their status as determined through this evaluation.

Table 4. Evaluation of delivery against MPfN PMP activities

Activity	Description	KPI delivery assessed as strong	Overall evaluation
B1	Project initiation	5/5 (100%)	Strong
B2	Project planning and management	5/5 (100%)	Strong
B3	Communication and extension	34/34 (100%)	Strong
B4	Extracting value from enhanced efficiency fertilisers (EEF)	22/23 (95%)	Strong
B5	Optimising nitrogen use efficiency (NUE) in irrigated systems	31/31 (100%)	Strong
B6	Better understanding N supply through mineralisation (quantifying rate and timing)	34/34 (100%)	Strong
Overall evaluation of delivery against the MPfN PMP		**132/133 (99%)**	**Strong**

Delivery against the MPfN Communication and Extension Plan

The CEP was completed in March 2017, in line with Activity B2, output 2(b) of the DoV. The CEP was prepared as the guiding document on communication and extension activities for the sector and research partners of the MPfN Program.

The CEP outlined 24 tools for internal and external communication and extension activities of the MPfN Program. Across the 24 tools in the CEP, 263 planned activities and outputs were identified. A document review showed 394 activities and outputs were completed against these planned tools

(Figure 1), equal to 150% of the total planned activities. An additional 46 activities and outputs were also registered as completed in the M&E database that did not directly align with the planned tools[2].

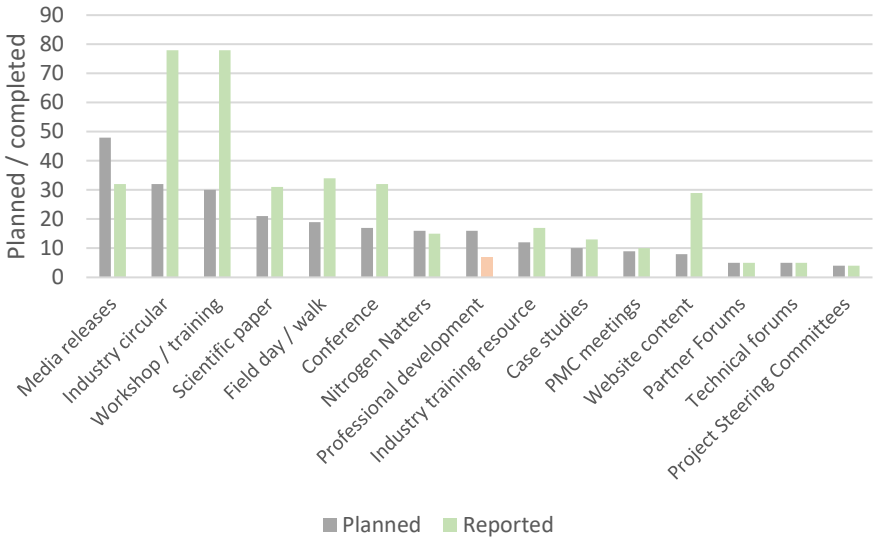

Figure 1. CEP tools: planned and completed

Based on the completion of planned activities and outputs, the MPfN is assessed to have achieved strong delivery against the CEP, with 22 out of 24 (92%) individual CEP tools evaluated as strongly achieved (Table 5). A full breakdown of the individual CEP tools with evaluations is in *Appendix G*.

Table 5. Evaluation of delivery against the MPfN Communication and Extension Plan

M&E area	Planned tools	Delivery of CEP tools assessed as strong	Overall evaluation
Internal communication and extension	PMC, Science Coordinator, Program Partner Forums, Project Steering Committees, Dairy Industry Forums, Nitrogen Natters, Partner webinars and professional development, emails, workshops.	8/9 (89%)	Strong
External communication and extension	Science Coordinator, Websites, Industry Extension, Social Media, Industry Circulars, Media Releases, Program Booklet, Comms templates, Industry resources, Field days /workshops, technical forums, videos/case studies, project interim and final reports, conferences, science journals.	14/15 (93%)	Strong
Overall evaluation of delivery against the MPfN CEP		**22/24 (92%)**	**Strong**

Delivery against the MPfN Monitoring and Evaluation Plan

The final MEP was completed in April 2017, in line with Activity B2, output 2(c) of the DoV. The MEP contains 42 performance indicators across four M&E areas (Table 6). Through a review of MPfN documentation, and quantitative and qualitative feedback from stakeholders, 83% of performance indicators were assessed as strongly achieved, and overall delivery against the MEP was assessed as strong. The remaining seven performance indicators (17%) were evaluated as having been moderately achieved, which was primarily due to stakeholders rating the MPfN as moderately effective in achieving some specific research and extension outcomes. *Part 2* provides more detail on this by

[2] The fields used in the M&E database for labelling individual activities and outputs did not directly align to those identified in the CEP. The activities and outputs were aligned where possible in consultation with the Science Coordinator to make an evaluation of their completion.

reviewing the effectiveness of the MPfN delivery against program objectives. A full list of the MPfN performance indicators making up the MEP is shown in *Appendix* H, including details on their assessed achievement.

Table 6. Evaluation of MPfN MEP performance indicators

M&E area	Description	Performance indicators assessed as strong	Overall evaluation
Initiation activities	Underpinning structures and process—What will be managed and how?	9/10 (90%)	Strong
Program Materials	Research and stakeholder adoption—What will the project produce?	7/8 (88%)	Strong
Program Activities	Research and stakeholder engagement outputs—What will the project deliver?	9/12 (75%)	Strong
Intermediate outcomes	Achievable within the life of the project—What will result from the project activities?	10/12 (75%)	Strong
Overall evaluation of delivery against the MPfN MEP		**35/42 (83%)**	**Strong**

Stakeholder feedback on program delivery

Internal stakeholders were asked to rate the effectiveness of internal planning, monitoring, and reporting in supporting the delivery of research, communication and extension objectives. All stakeholder groups rated these processes highly, with an average rating of 4.2 (n=34) (Table 7). This is comparable to the high rating from the mid-term evaluation (average rating 4.3, n=27).

When asked specifically about the administrative support from CRDC as Program Manager, the Science Coordinator, and the RDC partners, stakeholders rated the support as highly effective (average rating 4.2, n=26) (Figure 2). In particular, the support provided by the Science Coordinator gained the highest rating of all questions asked in the survey (average rating 4.7, n=26).

Table 7 Quantitative feedback summary: project planning, monitoring and reporting

Average score by stakeholder type	
Stakeholder group	**Rating**
RDC	4.2 (n=6)
Research leader	4.3 (n=12)
Research team member	4.1 (n=18)
Research partner	NA
Industry service provider	NA
Producer / grower	NA
Industry group	
Sugarcane	4.1 (n=8)
Dairy	4.5 (n=8)
Cotton	4.3 (n=7)
Mango	4.0 (n=8)
Cherry	4.0 (n=4)
Stakeholder average	**4.2 (n=34)**

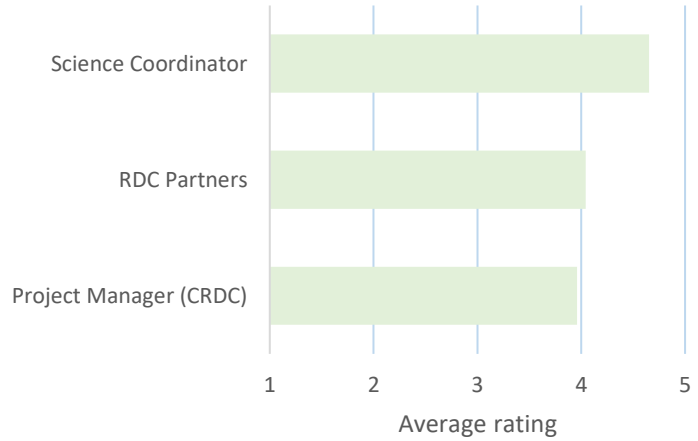

Figure 2. Stakeholder rating of administrative support

Stakeholder comments were overall highly supportive of the MPfN internal planning, monitoring and reporting processes, and the extent to which they supported project research and extension objectives (Table 8). Across the stakeholder ratings and comments, the support provided by the Science Coordinator was noted as being particularly effective at ensuring the successful delivery of the program. Among sugar and cotton stakeholders there were 5 comments that lengthy delays in the initial contracting process created follow on issues, including payment delays and the ability to

coordinate research staff; however, all stakeholders reflected that once contracted, the project was managed to a high standard.

Table 8 Qualitative feedback summary: project planning, monitoring and reporting

Sub-theme	Sample quotes	Sugar	Cotton	Dairy	Mango	Cherry	Total
A great program to be involved in / overall well planned and delivered.	*The program was well coordinated and will no doubt provide a valuable addition to industry knowledge (sugar)*	6 29%	0	5 26%	0	2 22%	**13** **19%**
Science coordinator was really effective / a great asset / should be brought in earlier to help planning.	*The Science Coordinator has been a real asset to the program. An excellent communicator and organiser (mango)*	4 19%	3 20%	1 5%	3 30%	3 33%	**13** **19%**
Internal reporting and communication processes were well organised / really effective / timely / Science Coordinator did a great job with this	*In terms of program facilitation; online database, templates for reports, all very well managed. Have a look at how this program was managed and use that as a benchmark for how others should be managed (dairy)*	2 10%	1 7%	3 16%	1 10%	1 11%	**7** **10%**
Integrating contracting timelines across organisations caused problems / contracting was convoluted / significant delays	*Unfortunately a lot of delays in contracting. So this an area to improve; convoluted process. But once set up no issues with commss, reporting or management (sugar)*	3 14%	2 13%	0	0	0	**5** **7%**
M&E database was a useful reporting tool for the program.	*The database ensured that data that were needed for measuring research impact were collated and reported in a useful way (cotton)*	0	1 7%	2 11%	0	0	**3** **4%**
Basic templates for presentation and branding were not well developed / was a bit confusing / could have been done better.	*The standard PowerPoints were not properly constructed, so couldn't actually be used effectively. Had to be converted into a formal PowerPoint template (dairy)*	2 10%	0	1 5%	0	0	**3** **4%**
Would have benefited from greater integration of objectives and research with other N research outside of MPfN / More planning on this at an industry level.	*MPfN sits as one facet of research in N use in the sugar industry, but perhaps it was not well enough connected to other research being conducted (sugar)*	3 14%	0	0	0	0	**3** **4%**

Concluding remarks on the evaluation of program delivery

The delivery of MPfN activities and outputs against the three MPfN Plans was evaluated as strong overall. Across the three MPfN plans, there was an average 91% of planned outputs evaluated as strongly delivered (Table 9).

Table 9. Summary of evaluation of program delivery against the MPfN plans

MPfN plan	Elements rated as strong	Overall evaluation
Overall evaluation of delivery against the MPfN PMP	132/133 (99%)	Strong
Overall evaluation of delivery against the MPfN CEP	22/24 (92%)	Strong
Overall evaluation of delivery against the MPfN MEP	35/42 (83%)	Strong
Overall stakeholder rating of planning, monitoring and reporting	4.2 (n=34)	Strong
Overall evaluation of delivery against the MPfN plans (average rating)	**91%**	**Strong**

The level of program outputs registered in the M&E database far exceeded those planned in the CEP, and internal stakeholders rated the project planning, monitoring and delivery as highly effective

(average 4.2, n=34), and the administrative support provided as highly effective (average 4.2, n=26), with generally positive comments supporting these ratings.

While the evaluation of the PMP and CEP focussed on the delivery of planned activities and outputs, the evaluation of the MEP performance indicators included stakeholder feedback on the effectiveness of the activities and outcomes in achieving program objectives. *Part 2* provides more detail on this by reviewing the effectiveness of the MPfN delivery against program objectives.

PART 2: EVALUATION OF DELIVERY AGAINST MPFN OBJECTIVES

Building on the evaluation of delivery of activities and outputs in *Part 1. Evaluation of delivery against program plans*, *Part 2* evaluates the MPfN Program success in achieving its primary and secondary objectives.

Primary objectives:

- Generate greater knowledge and understanding of the factors that influence NUE across the four industries.
- Identify new NUE strategies and technologies, or update or validate existing NUE strategies and technologies to inform NUE resources across the four industries.

Secondary objectives:

- Support the establishment and fostering of industry and research collaborations that form the basis for ongoing innovation and growth of Australian agriculture.
- Support strengthened pathways to extend the results of rural R&D, including understanding the barriers to adoption.

To evaluate the MPfN primary and secondary objectives, feedback was collected quantitatively and qualitatively across internal and external groups.

Generate knowledge and understanding

For each of the three key research areas, stakeholders were asked to rate the extent to which the MPfN Program achieved its primary objective of increasing industry knowledge and understanding of factors affecting NUE across the four industries.

Overall, respondents rated the MPfN highly for generating increased knowledge across each of the individual MPfN research activity areas (overall average 3.9, n=62) (Table 10). This is an improvement on the stakeholder ratings from the mid-term evaluation, where stakeholders rated the MPfN as moderate for contributing to increased industry knowledge and understanding (average rating 3.4, n=31), which highlights the progression of the sub-projects in finalising research results and communicating the findings to industry.

Breaking down the responses into the two primary stakeholder groups, the research group rated the contribution to knowledge and understanding highly across all research activity areas (average 4.1, n=44), while the industry group rated the contribution to knowledge and understanding as moderate (average rating 3.6, n=18).

Table 10. Stakeholder rating of MPfN Program contribution to NUE knowledge and understanding

Contribution to increased industry knowledge and understanding				
Stakeholder group	**EEFs (activity B4)**	**Interplay of N factors (activity B5)**	**Mineralisation and N budgets (activity B6)**	**Average**
RDC	3.6 (n=5)	3.9 (n=6)	4.1 (n=5)	3.9 (n=6)
Research leader	4.0 (n=10)	4.2 (n=10)	4.2 (n=11)	4.1 (n=12)
Research team member	4.1 (n=17)	4.1 (n=19)	4.1 (n=17)	4.1 (n=21)
Research partner	4.1 (n=5)	4.2 (n=5)	3.5 (n=4)	3.9 (n=5)
Industry service provider	3.7 (n=9)	3.4 (n=10)	3.8 (n=11)	3.6 (n=11)
Producer / grower	3.7 (n=5)	3.7 (n=5)	3.8 (n=6)	3.7 (n=7)
Industry group				
Sugarcane	3.9 (n=20)	3.6 (n=18)	3.7 (n=15)	3.7 (n=20)
Dairy	3.9 (n=16)	3.9 (n=18)	4.1 (n=17)	4.0 (n=18)
Cotton	3.8 (n=13)	3.7 (n=10)	3.7 (n=11)	3.8 (n=13)
Mango	3.3 (n=3)	4.0 (n=10)	4.2 (n=10)	3.8 (n=10)
Cherry	3.7 (n=3)	3.8 (n=4)	4.3 (n=6)	3.9 (n=6)
Stakeholder average	**3.9 (n=51)**	**3.9 (n=55)**	**4.0 (n=54)**	**3.9 (n=62)**

Stakeholder comments on the MPfN contribution to increased knowledge and understanding of NUE closely reflected the ratings provided, with overall comments being generally positive (Table 11).

Stakeholders recognised a strong contribution to knowledge across the three research areas and across all industries, with the MPfN addressing previous knowledge gaps particularly at a research level. Across most industries, stakeholders commented that the research findings often confirmed or reinforced existing knowledge or practice, which was an important process in increasing industries confidence in N management, and a primary objective to validate existing N practices. The exception to this was mango, reflecting the previous lack of existing N management recommendations for the northern mango industry and highlighting the importance of the MPfN research in addressing this gap.

EEFs generated the highest number of specific comments, with respondents noting the contribution of the research to understanding the interplay of EEFs with different soils and climate, but also recognising that there is still a lot of uncertainty surrounding the effectiveness of different EEF products in relation to these other factors. These comments on EEFs support the lower ratings for knowledge and understanding of EEFs identified above.

Table 11. Stakeholder comments on MPfN contribution to NUE knowledge and understanding

Sub-theme	**Sample quotes**	**Sugar**	**Cotton**	**Dairy**	**Mango**	**Cherry**	**Total**
Mineralisation knowledge: addressed data gap for tree litterfall and mineralisation / increased understanding of the long life-cycle of N in orchards / clarified N application in Autumn	*The MPfN project has enabled more accurate values to be placed on N dynamics, such as mineralisation and the reason for seasonality in N response, which will provide industry with greater knowledge for decision making around N nutrition (dairy)*	2 10%	4 27%	8 42%	6 60%	4 44%	**23** **33%**
EEF knowledge: Addressed a lot of assumptions relating to EEFs, soil, and SOC / better understanding of cost effectiveness of EEFs	*Our project contributed to further understanding of the implications of DMPP upon N release from urea-based fertiliser and how this affects desorption of SOC (cotton)*	6 29%	4 27%	5 26%	4 40%	3 33%	**21** **30%**
Interplay of soils, climate, and management knowledge: Filled a huge knowledge gap / water influence on N use was a big gap / climate is the most significant factor in N losses	*We had very little knowledge on the seasonal dynamics of nitrogen use in cherry orchards up until we commenced these trials. The ^{15}N trial facilitated new knowledge and understanding of NUE in this context for both researchers and industry (cherry)*	2 10%	5 33%	8 32%	4 40%	3 33%	**21** **30%**

Re-enforced and refined current NUE knowledge / clarified unsubstantiated assumptions, recommendations, and practice	*Confirms practices you have been doing for years. Gives the confidence on when, why, how much (dairy)*	3 14%	2 13%	7 37%	0	2 22%	**14** **20%**
Highlighted the importance of considering varying seasonal conditions and soil types when considering EEFs.	*One recommendation was to consider and understand seasonal potential. If they have a prediction of seasonal rainfall then this may influence the application of EEFs. This was not necessarily previously considered (sugar)*	3 14%	0	3 16%	1 10%	0	**7** **10%**
Still a lot of uncertainties about EEFs / different products and factors / could not find savings in N losses from EEFs / variable responses to EEFs / trials were affected by weather conditions and residual soil N.	*Still a lot of uncertainty around EEFs (dairy)*	1 5%	2 13%	3 16%	0	0	**6** **9%**

Inform NUE resources

Across each of the key research areas, stakeholders were asked to rate the extent to which the MPfN achieved its secondary objective to identify new NUE strategies and technologies, or update or validate existing NUE strategies and technologies to inform NUE resources across the four industries.

On average across all research areas, respondents rated the MPfN moderately for informing NUE resources (overall average 3.6, n=60) (Table 12). This is consistent with the ratings from the mid-term evaluation (average rating 3.6, n=33).

Breaking down the responses into the two primary stakeholder groups, both the research group and the industry group rated the MPfN as moderate for contributing to NUE resources across all research activity areas (research group average 3.6, n=43; industry group average 3.4, n=17).

Table 12. Stakeholder rating of MPfN Program contribution to NUE resources

Contribution to NUE resources				
Stakeholder group	**EEFs (activity B4)**	**Interplay of N factors (activity B5)**	**Mineralisation and N budgets (activity B6)**	**Average**
RDC	4.0 (n=4)	3.5 (n=6)	3.4 (n=5)	3.6 (n=6)
Research leader	3.4 (n=10)	3.8 (n=8)	3.5 (n=10)	3.6 (n=11)
Research team member	3.6 (n=15)	3.9 (n=19)	3.6 (n=16)	3.7 (n=21)
Research partner	3.6 (n=5)	3.8 (n=3)	4.3 (n=2)	3.9 (n=5)
Industry service provider	3.3 (n=8)	3.4 (n=9)	3.9 (n=10)	3.5 (n=10)
Producer / grower	3.1 (n=4)	3.6 (n=5)	3.3 (n=5)	3.3 (n=7)
Industry group				
Sugarcane	3.6 (n=17)	3.5 (n=15)	3.3 (n=12)	3.5 (n=19)
Dairy	3.6 (n=15)	4.0 (n=17)	4.1 (n=15)	3.9 (n=17)
Cotton	3.4 (n=11)	3.3 (n=8)	3.1 (n=9)	3.2 (n=12)
Mango	1.0 (n=1)	3.9 (n=8)	3.8 (n=8)	2.9 (n=8)
Cherry	3.0 (n=2)	4.0 (n=3)	3.6 (n=5)	3.5 (n=5)
Stakeholder average	**3.5 (n=46)**	**3.7 (n=50)**	**3.6 (n=48)**	**3.6 (n=60)**

In contrast to the moderate ratings, stakeholder comments on the MPfN contribution to NUE resources were mostly positive (Table 13).

Across all industries, the most common theme (14 comments, 20% of stakeholders) was a recognition of the positive contribution of the MPfN to the development of new or updated resources in the latter phase of the program, or as the next step for the individual industries. Consistent with the ratings, the

most comments on this were from dairy industry stakeholders (7 comments, 37% of dairy stakeholders), which reflected on the effective integration of the research findings into industry resources including updated Fert$mart Nitrogen Guidelines, an NUE Pocket Guide and an NUE calculator. Cotton industry stakeholders also had a relatively high level of positive comments (4 comments, 27% of cotton stakeholders) on the work to integrate the findings into the 2021 Australian Cotton Production Manual, which is a key production resource for the cotton industry.

Across all four industries, stakeholders also commented that the development of resources was not the primary objective of the MPfN, but that the program had delivered clear R&D outputs and made them available to industry for inclusion in NUE resources going forward (6 comments, 9% of stakeholders).

Table 13. Stakeholder comments on MPfN Program contribution to NUE strategies and technologies

Sub-theme	Sample quotes	Sugar	Cotton	Dairy	Mango	Cherry	Total
New / improved resources have been / are being developed	*The integration of dairy R&D findings into industry BMPs was a highly effective means of focussing interpretation and a path to next and end users of knowledge (dairy)*	1 5%	4 27%	7 37%	1 10%	1 11%	**14** **20%**
Mineralisation: dairy mineralisation calculator was useful / relationship between litterfall and N mineralisation will improve N budgeting.	*It has become apparent that there is a lot of carryover N in the soil of high-yielding cotton farms that is not being accounted for in N fertiliser recommendations (cotton)*	2 10%	0	4 21%	2 20%	2 22%	**10** **14%**
EEFs: MPfN program generated new tools and recommendations relating to EEF products / blends which result in increased NUE under a range of soil, climatic and system conditions	*Developed a practical tool. Depending on different harvest dates, applications, weather, it helps guide which combination of N to use, including EEF (sugar)*	4 19%	0	2 11%	0	2 22%	**8** **12%**
Developing resources is industries job going forward / research was mostly foundational / more practical tools are required for industry	*The research was more focussed on fundamentals, so there is a need now to support this with specific tools and strategies (Sugar)*	2 10%	2 13%	1 5%	1 10%	1 11%	**6** **9%**
Interplay of soils, climate, and management: Good resources and recommendations relating to seasonal demand / N supply and fruit quality / good rules of thumb on the interaction of soils and climate and N.	*Some of the recommendations about timing of application were good as it confirmed what we had heard from overseas that uptake efficiency is greater in spring rather than post harvest (cherry)*	2 10%	0	1 5%	1 10%	2 22%	**6** **9%**

Support research collaboration

Feedback was sought from internal stakeholders to assess how effectively the MPfN Program achieved its secondary objective of supporting research collaboration. Across 9 collaboration activities (Figure 3), stakeholders gave average ratings of between 3.4 (moderately effective in supporting collaboration) to 4.5 (highly effective at supporting collaboration). On average, stakeholders rated the MPfN activities highly for supporting collaboration (average rating 4.0, n=33), which is comparable to the high rating of 4.1 (n=28) from the Mid-Term Evaluation.

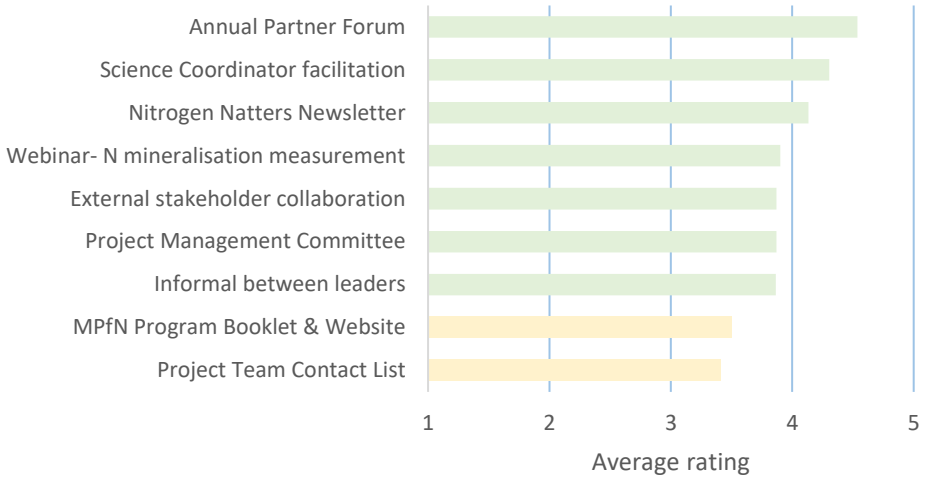

Figure 3. Rating of the effectiveness of MPfN activities in supporting collaboration

Stakeholder comments on MPfN research collaboration were mostly positive, with five main themes (Table 14). Stakeholders focussed on the overall effectiveness of MPfN activities in supporting inter and intra-industry collaboration, and singled out the Annual Partner Forums and Nitrogen Natters for particular praise. A small number of sugar and cotton industry stakeholder commented that more could have been done to support collaboration through more integrated research objectives and synthesis of results; however, MPfN planning time-constraints reduced the focus on this area.

Table 14. Qualitative feedback summary: program collaboration activities

Sub-theme	Sample quotes	Sugar	Cotton	Dairy	Mango	Cherry	Total
MPfN supported collaborative research across all participating industries / you can piggy-back on what other researchers are doing and learn a lot.	*There are enough commonalities between the different industries and the underlying science. Having the workshops and formats have enabled me to avoid some pitfalls based on other industry research (sugar)*	5 24%	6 40%	3 16%	2 20%	3 33%	**18** **26%**
MPfN supported collaborative research within the same industry group / Grouping of the industry relevant teams together strengthens industry specific research collaboration.	*The MPfN program has been very productive, and the national coordination provides great opportunities for collaboration and information exchange. Grouping the industry teams together also strengthens industry specific research collaboration (dairy)*	3 14%	1 7%	2 11%	0	2 22%	**8** **12%**
Annual meetings very effective / Partner Forum worked really well / great opportunity to interact with MPfN community / workshops were a great opportunity to share knowledge and gain feedback.	*Really enjoyed the partner forums, and being able to have conceptual discussion about NUE and mineralisation and how to present that (cherry)*	1 5%	2 13%	3 16%	0	1 11%	**7** **10%**
Nitrogen Natters was really useful to understand other research / a go-to cross-industry read.	*Nitrogen Natters has been my go-to cross industry read (mangos)*	1 5%	3 20%	0	1 10%	1 11%	**5** **7%**
MPfN planning time constraints limited the identification of specific cross sectoral activities and integrated objectives / More could have been done to allow cross-industry synthesis of results.	*Could have better identified the objectives and more specific cross project activities that would have improved collaboration. There was cross sectoral collaboration, but more time to build that component. The opportunity is to value add with more explicit cross sectoral activities. (cotton)*	2 10%	1 7%	0	0	0	**3** **4%**

Support extension pathways

As identified in *Part 1*, program delivery against the CEP was evaluated as strong, with 150% of planned activities and outputs delivered. This section builds on that assessment by evaluating the effectiveness of the MPfN extension and communication in line with the MPfN secondary objective to support R&D extension pathways.

Overall, stakeholders rated the MPfN extension and external communication activities as being moderately effective at communicating the outcomes of the program and demonstrating industry opportunities for greater production and profit through increased NUE (average rating 3.6, n=61) (Table 15). This is lower than the mid-term evaluation rating of 3.8 (n=41), potentially reflecting the cancellation or modification of some planned activities in the last two years of the program as a result of COVID restrictions. On average research level stakeholders provided a high rating (average rating 3.7, n=42) while industry level stakeholder provided a moderate rating (average 3.6, n=19).

Stakeholders were also asked to rate the effectiveness of individual MPfN extension and communication activities at disseminating relevant project information to industry (Figure 4). Individual activities were rated from moderate to high (average rating 3.7, n=63), with in-person events viewed as the most effective at disseminating the project information. On average, research level stakeholders rated the extension activities highly (average 3.7, n=44), while industry level stakeholders rated extension activities as moderate (average 3.5, n=19).

Table 15. Stakeholder rating of MPfN Program extension and external communication

Average score by stakeholder group	
Stakeholder group	**Rating**
RDC	3.3 (n=6)
Research leader	3.8 (n=12)
Research team member	3.8 (n=19)
Research partner	3.4 (n=5)
Industry service provider	3.7 (n=12)
Producer / grower	3.4 (n=7)
Industry group	
Sugarcane	3.5 (n=20)
Dairy	3.9 (n=19)
Cotton	3.7 (n=11)
Mango	3.9 (n=8)
Cherry	3.1 (n=8)
Stakeholder average	**3.6 (n=61)**

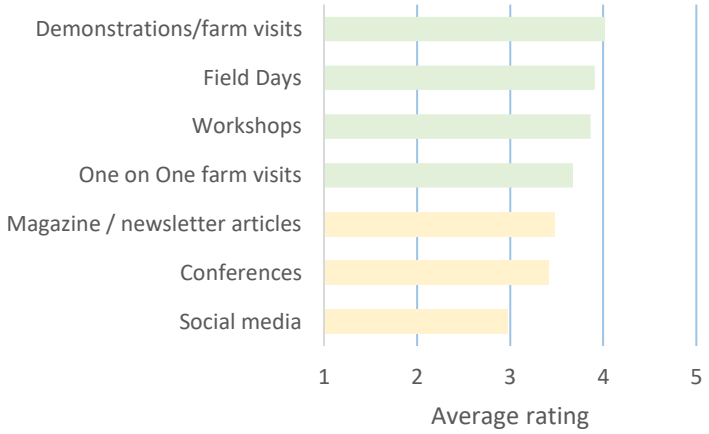

Figure 4 Stakeholder rating of individual extension and comms

Stakeholders commented extensively on the effectiveness of MPfN extension and communication activities at conveying the research findings (Table 16). Comments were mostly positive, with the highest level of feedback relating to the effectiveness of the in-person extension activities (23 comments), consistent with the ratings in Figure 4. Stakeholders also identified the effectiveness of targeting service providers to generate a multiplier effect, including through collaborations with Fertilizer Australia. The MPfN success in this area directly aligns with the RRD4P intent to focus on the growing role of private service delivery in industry RD&E and adoption[3].

Across all industries with the exception of cotton, there were 16 comments that there had not been enough extension to effectively convey or re-enforce the research findings and recommendations. Of note, industry level stakeholders commented on this perceived lack of extension at a higher rate (7 comments, 30% of industry stakeholders) compared to research level stakeholders (9 comments, 20% of research stakeholders), and at the same time, research level stakeholders in all industries recognised that extension of the MPfN final recommendations was not a primary MPfN objective, but

[3] Grosvenor Management Consulting, 2017, *Evaluation of the Rural Research & Development (R&D) for Profit Program Final Report*, Canberra, 15 December 2017.

was instead primarily the responsibility of industries going forward. As such, the industry stakeholder perception of a lack of extension was likely linked to their lack of awareness of the MPfN's primary focus on research, and the ongoing work to integrate the MPfN findings into industry resources and extension programs.

COVID was widely noted (12 comments) as having disrupted the extension of results through the preferred use of face-to-face events; however, online communications were identified by some respondents as being effective at partially mitigating this disruption. These COVID impacts in the latter part of the MPfN program potentially contributed to the perceived lack of extension by some stakeholders, and also, as previously identified, the lower rating of extension activities compared to the Mid-Term Evaluation.

Demonstrating the economics was highlighted as a key focus area for extension to support producer confidence in the research (6 comments). The importance of this was recognised in the MPfN planning, and as a result the program has delivered, or is in the process of delivering, at least two economic case studies for each industry group that highlight the farm level economic benefits of applying the MPfN recommended strategies.

Table 16. Stakeholder comments on effectiveness of MPfN extension and external communication

Theme	Sample quotes	Sugar	Cotton	Dairy	Mango	Cherry	Total
In person extension was the most effective / allowed practical discussion with researchers and other growers	*Feedback from field days was always very positive and small group discussions at workshops were very targeted and cited as useful by the growers involved (cotton).*	8 38%	5 33%	4 21%	4 40%	3 33%	**23** **33%**
There hasn't been enough extension to convey / re-enforce the message / address barriers	*They have done an ok job at conveying the research but the frequency of communication has been lacking (cherry)*	5 24%	0	4 21%	2 20%	6 67%	**16** **23%**
Extension has been really well done / coordination between researchers improved extension / engagement with growers and industry has been really successful	*Industry had great interaction with researchers so we are much more aware and prepared to manage N over the entire season and have benefited greatly from direct interaction with research staff (dairy)*	5 24%	1 7%	4 21%	1 10%	2 22%	**13** **19%**
Coordination with industry extension programs was effective	*There has been good collaboration with CottonInfo (cotton).*	1 5%	5 33%	2 11%	4 40%	0	**12** **17%**
COVID really impacted the number or effectiveness of extension activities	*COVID was very disruptive. We lost the face-to-face which made effective made communication harder (sugar)*	4 19%	0	2 11%	2 20%	4 44%	**12** **17%**
Extension was effective at tailoring the message / language to the audience / "farmer language" / practical recommendations.	*The fact that the research was thorough, and was translated into meaningful outcomes that farmers could understand and implement in their own business (dairy)*	0	2 13%	7 37%	0	3 33%	**12** **17%**
Extension wasn't really part of the project / wasn't explicitly written into the program / is industries job going forward	*Next step is identifying the best extension approach, which wasn't explicitly build into the program, so its industries job going forward (cotton)*	3 14%	4 27%	2 11%	1 10%	1 11%	**10** **14%**
Targeting service providers / agronomists and retailers generated an impact multiplier	*Service providers are increasingly more influential, so targeting them is a more effective pathway for getting industry adoption (dairy).*	3 14%	0	4 21%	0	0	**7** **10%**
A lack of simple, easily accessible, practical extension and communications / needs to be condensed into simple message / farmer language for extension	*What does it mean in 'real terms' and what can growers do in 'practical application' — provide growers with 'usable' information (sugar).*	2 10%	0	3 16%	1 10%	1 11%	**6** **9%**

Collaborations with the fertilizer industry was useful when engaging with service providers	*Collaborations with the fertiliser Australia very good (dairy).*	3 14%	1 7%	2 11%	1 10%	3 33%	**6** **9%**
Demonstrating the economics clearly is important to give growers confidence	*Economic analysis of the N impact on mangoes will provide basis for our extension activities after the project (mango).*	1 5%	0	4 21%	1 10%	0	6 **9%**
Online material and events were done well / social media was effective / helped to manage disruptions from COVID	*Farmers responded well to online videos. Great analytics on social. Social media are the best supporting material for the research, providing short, targeted messages (dairy).*	1 5%	0	3 16%	1 10%	0	**5** **7%**
Activities could be more spread out / could have started earlier / greater consideration of seasonal farming conditions and priorities that impact attendance and cut-through	*The seasonality is also a challenge. Especially in drought conditions when farmers are thinking of survival its really difficult to cut through some of those messages. You need to pick the time when farmers are most likely to want to hear the message and adopt, right time and head-space (dairy).*	1 5%	0	3 16%	0	0	**4** **6%**

Concluding remarks on the evaluation of delivery against program objectives

Overall, delivery of the MPfN against the program objectives was evaluated as strong (Table 17).

Table 17. Summary of evaluation of program delivery against the MPfN objectives

Evaluation of successful delivery against the project objectives		**Average stakeholder rating**	**Overall evaluation**
Primary objectives	Generate knowledge and understanding	3.9 (n=62)	Strong
	Inform NUE resources	3.6 (n=60)	Moderate
Secondary objectives	Support collaboration (internal stakeholders only)	4.0 (n=33)	Strong
	Support extension pathways	3.6 (n=61)	Moderate
Overall evaluation of delivery against the MPfN objectives (average rating)		**3.8**	**Strong**

Across the MPfN objectives, the perceived effectiveness against research level outcomes (research level knowledge and fostering collaboration) was strong, reflecting the delivery of a high level of research outcomes for what was fundamentally a research program.

While the perceived effectiveness against industry level outcomes (industry level resources, extension, and changes in industry level knowledge) was moderate, the lower ratings were consistent with these being primarily secondary objectives of the program. In particular, comments recognised that while the MPfN delivered clear R&D outputs to inform industry resources (a primary objective), responsibility for integrating the findings into industry resources and extending these to growers lay primarily with the individual industries and would continue beyond the completion of the MPfN. In addition, while all industries had begun to integrate the MPfN recommendations into industry resources, or had plans to do so, the comments indicated that service providers and producers were not as aware of this ongoing process, which likely contributed to their lower scores in this area.

PART 3. EVALUATION OF IMMEDIATE AND LEGACY IMPACT

This section includes an evaluation of the immediate and legacy impact of the project upon industry nitrogen management practices. Based on feedback from MPfN stakeholders, this section assesses the extent to which the MPfN has resulted, or will over time result in greater confidence to adopt the NUE strategies and recommendations; the barriers that might affect the rate and level of adoption; and the potential economic and environmental impact areas that could result from adoption.

Confidence to adopt the NUE strategies and recommendations

Stakeholders were asked to rate the extent to which the MPfN program has resulted, or will result in greater producer confidence to adopt the strategies and recommendations relating to the three NUE research areas. Overall, stakeholders rated the MPfN moderately for influencing producer confidence to adopt the NUE strategies (average rating 3.7, n=65) (Table 18). Across the three individual research areas, stakeholders singled out the MPfN for being the most effective at increasing producer confidence to adopt NUE strategies relating to N mineralisation. The lower rating for confidence to adopt the research findings on EEF products reflects the stakeholder comments that there remained a lot of uncertainties around EEFs (see *Part 2. Evaluation of program delivery against MPfN objectives*).

Table 18. Stakeholder rating of the extent to which the MPfN Program will result in greater confidence to adopt NUE strategies across the three research areas

Average score by stakeholder group				
Stakeholder group	**EEFs (activity B4)**	**Interplay of N factors (activity B5)**	**Mineralisation and N budgets (activity B6)**	**Average**
RDC	4.0 (n=4)	3.2 (n=5)	3.0 (n=5)	3.4 (n=5)
Research leader	3.3 (n=9)	4.1 (n=10)	4.0 (n=12)	3.8 (n=12)
Research team member	3.4 (n=18)	3.5 (n=19)	3.9 (n=20)	3.6 (n=22)
Research partner	4.0 (n=5)	2.8 (n=4)	4.2 (n=5)	3.7 (n=5)
Industry service provider	3.5 (n=10)	3.7 (n=11)	4.0 (n=11)	3.7 (n=11)
Producer / grower	3.5 (n=6)	3.7 (n=7)	3.8 (n=8)	3.6 (n=8)
Industry group				
Sugarcane	3.6 (n=19)	2.8 (n=12)	3.6 (n=17)	3.3 (n=19)
Dairy	3.7 (n=15)	3.8 (n=17)	4.1 (n=18)	3.8 (n=18)
Cotton	3.5 (n=13)	3.9 (n=15)	3.8 (n=13)	3.7 (n=15)
Mango	2.3 (n=3)	3.6 (n=9)	3.7 (n=10)	3.2 (n=10)
Cherry	3.3 (n=6)	3.4 (n=8)	3.5 (n=8)	3.4 (n=8)
Stakeholder average	**3.5 (n=52)**	**3.6 (n=56)**	**3.8 (n=61)**	**3.7 (n=65)**

In support of the ratings on producer confidence to adopt the MPfN recommendation, stakeholders also provided comments on the extent to which adoption was already taking place, was likely to occur, or was unlikely or unknown (Table 19). Across all industries the comments were net positive (adoption has already occurred or is likely to occur with time) with the exception of the cotton industry, where there were more comments that adoption was unlikely or unknown.

Table 19 Qualitative feedback summary: intent of industry to adopt MPfN recommendations

Sub-theme	**Sample quotes**	**Sugar**	**Cotton**	**Dairy**	**Mango**	**Cherry**	**Total**
Already identified industry adoption	*Very interesting the findings for the industry, especially with the findings of N left in leaf litter. So we have changed our management and don't add as much nitrogen now (mango).*	2 10%	3 20%	4 21%	3 30%	0	**12** **17%**
Likely to see adoption with time / with further extension	*Full impact of the new knowledge generated by the MPfN project will occur over time (not straight away) as it is incorporated into industry extension/literature and is it becomes known by the wider industry (dairy).*	4 19%	0	4 21%	1 10%	3 37%	**12** **17%**
Unlikely / unknown	*Research is not necessarily dealing with the drivers for N use on cotton farms. They have produced great information, very practical results, and they are communicating well, but it's not translating into impact (cotton).*	2 10%	4 27%	3 16%	1 10%	2 22%	**11** **16%**

When asked to comment on the barriers that currently affect or are expected to affect the speed or level of producer adoption of MPfN program outputs, 75% of stakeholders responded, which was the highest response rate for all open-ended questions. Comments were aligned to themes covering economic, social, and practical factors (Table 20). In addition, stakeholders identified a lack of extension of the program recommendations as a potential barrier. As previously discussed (*Part 2. Support Extension Pathways*), extension was not a primary objective of the MPfN, so this potential barrier presents a key risk and challenge to participating industries going forward, but one that can be managed with the effective integration of the MPfN findings and recommendations into industry resources and extension programs.

Table 20. Stakeholder comments on issues and barriers that will affect the speed or level of adoption

Theme	Sample quotes	Sugar	Cotton	Dairy	Mango	Cherry	Total
N is cheap insurance / Risk averse / Too risky to lose potential production	*Secure crop production and cane supply is often an overriding consideration given the cost of production and sugar price - N in urea form is considered 'cheap insurance" (sugar).*	4 19%	6 40%	4 21%	3 30%	5 56%	**21** **30%**
There hasn't been enough extension to convey / re-enforce the message / address barriers	*They have done an ok job at conveying the research but the frequency of communication has been lacking (cherry)*	5 24%	0	4 21%	2 20%	6 67%	**16** **23%**
Alternative sources of N are too expensive	*EEF has potential, but cost inhibitive. If the economics were there I'm sure people would use them (cotton)*	7 33%	3 20%	1 5%	1 10%	3 33%	**11** **16%**
More regionalised trials and recommendation (climate / soil) would support greater long-term adoption	*I think the major issue that might affect the speed or level of producer adoption is the validation of the results under uncertain climatic conditions (mango)*	6 29%	0	4 21%	1 10%	0	**11** **16%**
Practicalities of farming (labour, cashflow, time, technology) may limit the ability to adopt	*Best practice is best practice if you have the cashflow to support it. Labour is also a factor, for best nitrogen use you want to get application spot on, but you cant always get labour in when you need it (dairy)*	1 5%	4 27%	2 11%	0	0	**7** **10%**
N is not a large input cost / is not a primary issue of concern for farmers	*For horticulture, the big ticket items is labour. So a little bit of nitrogen is very small. Grower motivation is not to save money on nutrition but to maximise yield/quality (cherry).*	0	0	1 5%	3 30%	2 22%	**6** **9%**
PCU residue a potential environmental concern	*Still questions about some of the EEF products. The PCU stays in the soil and can be washed away. Would be better if biodegradable. Environmental impact which comes back to haunt the industry (sugar).*	3 14%	0	0	0	0	**3** **4%**
Needs more information on the longer term implications of N management	*Concern about longer term lost productivity if holding back on N — demonstration of projects longer term would alleviate this (cherry)*	1 5%	1 7%	0	0	1 11%	**3** **4%**

Potential impact areas

Stakeholders commented on several MPfN impact areas that had already been identified as a result of adoption, or were expected following adoption (Table 21). These included research impacts (9 comments), profitability impacts (45 comments), and environmental impacts (27 comments). In addition, there were 19 comments across all industries that profitability or environmental impacts were unknown, unlikely, or minor.

Table 21. Stakeholder comments on observed or expected impacts as a result of adoption

Theme	Sample quotes	Sugar	Cotton	Dairy	Mango	Cherry	Total
Research impacts							
Furthering N research areas / capacity building through PhDs / identified new research methods	*Some fabulous student projects in both mangoes and cherries who've made a great impact on the growers/farms they worked on and the industry. Good to see capacity building as a strong output in this sort of project (mango)*	3 14%	2 13$	3 16%	1 10%	0	**9** **13%**
Profitability impacts							
Increased application efficiency (timing, meeting crop needs)	*Over the long term it will definitely be a better fertilizer recovery from more efficient timing application. We haven't improved yield but we have reduced N application to improve productivity (cotton)*	4 19%	4 27%	5 26%	4 40%	0	**17** **25%**
Reduced rates of applied N	*We are not going to get more revenue/yield necessarily, but we can achieve a much more efficient approach to nitrogen use with less application (mango)*	4 19%	3 20%	2 11%	6 60%	2 22%	**16** **23%**
Profit impact is unlikely / unknown / minor	*Not sure. The cost of N is very minimal within the overall cost of production for cotton. So, it's challenging better NUE with improved profits (cotton)*	2 10%	2 13%	2 11%	2 20%	2 22%	**10** **14%**
Improved yield / quality	*Increases in cane yields in wetter farms (sugar)*	2 10%	0	3 16%	2 20%	0	**7** **10%**
Increased profits in some seasons / soils from EEFs	*Productivity and environmental benefits that can stem from the use of EEF's are not observed in all years. It is highly dependent on the interaction of different factors (soil x climate x harvest time) (sugar)*	5 19%	1 7%	0	0	0	**5** **7%**
Environmental impacts							
Reduced system losses / leaching / run-off / emissions	*Keeping the N where it needs to be (in the rootzone), reducing off site impacts through runoff and deep drainage (cotton)*	7 33%	6 40%	4 21%	5 50%	3 33%	**24** **35%**
Environmental impact is unlikely / unknown / minor	*Cannot see this in short-term in the systems examined (dairy)*	1 5%	0	5 26%	2 20%	1 11%	**9** **13%**
PCU residue a potential environmental concern	*Still question marks about some of the products. The polymer coat stays in the soil and can be washed away. Would be better if biodegradable. Environmental impact which comes back to haunt the industry or fertilizer company (sugar)*	3 14%	0	0	0	0	**3** **4%**

Concluding remarks on the evaluation of immediate and legacy impact

While stakeholders rated producer confidence to adopt as moderate; it is important to note that the timeframe for practice change within an agricultural R&D context can take years (or decades). It is rare for industry adoption of R&D to occur rapidly following the completion of the underlying research, but rather, adoption occurs in stages depending on the overlapping of a range of underlying factors including the strength of extension pathways and stakeholders' appetite for risk and change (social aspects), and underlying market conditions relating to the commodity and the innovation (economic aspects). A wide range of social and economic barriers were identified by MPfN stakeholders, with the

primary impediments being the perceived risk of missing out on lost productivity with reduced N application, combined with the low cost of traditional N sources such as urea. Together, these factors support a culture in many industries where N is applied as a form of cheap insurance to maximise productivity.

The identified social and economic factors present potential barriers to practice change, reducing the rate or level of overall adoption of new practices and technologies. Understanding and addressing these barriers to change where possible, and reinforcing the key research messages through industry specific resources and extension becomes critical to achieving incremental practice change and industry impact. While this process can be supported with communication and extension throughout the R&D process (as the MPfN has done through the delivery of 150% of planned communication and extension activities and outputs), it's success is ultimately dependent on extension of the final research results in the longer term following the completion of the research phase, with this responsibility falling to the industry research organisations and supporting industry bodies. Importantly, the significance of this ongoing process was clearly recognised by research level stakeholders through their feedback, and across all stakeholders, adoption was considered likely to occur over time as the MPfN recommendations are integrated into industry resources and extension programs. Promisingly, stakeholders commented that adoption was already evident in all industries, with demonstrated potential for economic and environmental benefits including yield or quality improvements, reduced N inputs, and reduced losses of N to the environment.

Considering the above, the MPfN's 1) strong contribution to generating knowledge and understanding; 2) identification of NUE strategies or technologies that were made available for inclusion (and in some cases already included) in industry NUE resources; and 3) contribution to a moderate (borderline high) industry confidence to adopt the NUE strategies, are together assessed to generate a strong immediate research impact, and a strong foundation supporting potential future adoption of NUE practices resulting in improved profitability and reduced environmental impact (Table 22). Importantly, it is up to individual industry research and extension bodies to convert this potential into realised NUE practice change and industry impact by continuing the process of integrating the MPfN recommendations into industry resources and extension programs, and understanding and addressing industry specific barriers to NUE practice change.

Table 22. Summary of evaluation of immediate and legacy impact to improve on-farm NUE

Evaluation of immediate and legacy impact to improve on-farm NUE	**Average stakeholder rating**	**Overall evaluation**
Generate knowledge (from *Part 2*)	3.9 (n=62)	Strong
Inform NUE resources (from *Part 2*)	3.6 (n=60)	Moderate
Confidence to adopt MPfN strategies and recommendations	3.7 (n=65)	Moderate
Overall evaluation of immediate and legacy impact (average rating)	**3.7**	**Strong**

Appendix A. MPfN sub-project details

The eleven projects under the MPfN program are presented in Table A1.

Table A1 MPfN project details

CRDC Agreement Code	Project Title	Research Organisation	Final reporting date	MPfN Final Evaluation stage
RRDP1712	More profit from nitrogen – Enhancing nutrient use efficiency in cotton	NSW DPI	30-Jun-21	2
RRDP1713	More Profit from Nitrogen – Optimising nitrogen and water interactions in cotton	USQ	30-Jun-18	1
RRDP1714	More Profit from Nitrogen – Increasing nitrogen use efficiency in dairy pastures	QUT	30-Nov-19	1
RRDP1715	More Profit from Nitrogen – Improving dairy farm nitrogen efficiency using advanced technologies	UoM	31-May-20	1
RRDP1716	More Profit from Nitrogen – Quantifying the whole farm systems impact of nitrogen best practice on dairy farms	UoM	30-Dec-20	1
RRDP1717	More Profit from Nitrogen – Improved nitrogen use efficiency through accounting for deep soil and mineralisable N supply, and deployment of Enhanced Efficiency Fertilisers to better match crop N demand	NSW DPI	31-May-20	1
RRDP1718	More Profit from Nitrogen – Smart blending of enhanced efficiency fertilisers to maximise sugarcane profitability	QDES	30-Apr-20	1
RRDP1719	More Profit from Nitrogen – New technologies and managements: transforming nitrogen use efficiency in cane production.	QDAF	30-Jun-21	2
RRDP1720	More Profit from Nitrogen – Optimising nutrient management for improved productivity and fruit quality in mangoes	NTDPIR	30-Jun-21	2
RRDP1721	More Profit from Nitrogen – Optimising nutrient management for improved productivity and fruit quality in cherries	TIA	30-Jun-21	2
RRDP1901	More profit from Nitrogen – Nitrogen use efficiency indicators for the Australian cotton, sugar, dairy and horticulture industries	CSIRO	30-Jun-19	Not individually evaluated

Appendix B. Key evaluation questions

Seven key evaluation questions (KEQ) were identified in the TOR (Table B1), and integrated into the project scope (Table B2).

Table B1. Key evaluation questions

Item	Key evaluation question
1	To what extent did the activities of MPfN contribute to increased understanding and knowledge of the factors which influence NUE across the four industries (both at a research and service provider/ producer level)?
2	To what extent did the activities of the Program identify new or update / validate existing NUE strategies/ technologies across the four industries (both at a research and service provider/ producer level)?
3	To what extent are key stakeholders confident that the MPfN activities have/ will over time result in greater confidence to apply NUE strategies resulting in more consistent profit and reduced environmental impact gains for primary producers of the four industries?
4	What evidence is there (anecdotal & outputs) that the research activities have effectively demonstrated opportunities for each industry to improve NUE without production loss or increased production and profit?
5	To what extent are key stakeholders confident that the MPfN planning, monitoring and reporting instruments assisted to effectively deliver upon the research, communication and extension objectives of the program?
6	What, if any, unintended outcomes (positive or negative) resulted from the MPfN (whole-of-program, research and service provider/ producer levels)?
7	What changes in implementation/processes could have improved effectiveness and/or impact?

Table B2. Alignment the KEQs to project scope

Project scope	**Key evaluation question alignment**						
	KEQ 1	KEQ 2	KEQ 3	KEQ 4	KEQ 5	KEQ 6	KEQ 7
Part 1. Evaluate program delivery against MPfN plans					✔		✔
Part 2. Evaluate program delivery against MPfN objectives	✔	✔		✔	✔	✔	✔
Part 3. Evaluate MPfN immediate and legacy impact	✔	✔	✔			✔	✔

Appendix C. Stakeholder consultation

The stakeholder register for the survey and interviews was confirmed with research project leads and the MPfN Science Coordinator. Table C1 shows the breakdown by stakeholder type of the 69 stakeholders engaged for the final evaluation.

Table C1. Stakeholder engagement by stakeholder type, industry, and project

Stakeholders group		Cotton		Dairy			Sugar			Mango	Cherry	All projects
		NSW DPI	USQ	QUT	UoM	UoM	NSW DPI	QDES	QDAF	NTDPIR	UTAS / TIA	
		1712	1713	1714	1715	1716	1717	1718	1719	1720	1721	
Research group	RDCs	2	2	1	1	1	2	2	2	1	1	**6**
	Research Project Leaders	2	1	1	1	1	1	1	1	2	1	**10**
	Research team	3	2	1	2	2	1	3	2	6	3	**24**
	Research Project Partners	1	0	0	0	0	1	4	2	0	0	**7**
Industry group	Industry Programs / Service Providers	3	3	2	6	6	2	1	1	1	2	**12**
	Producers/ Growers	2	0	1	1	0	1	2	0	1	2	**10**
Total stakeholders by project		**13**	**8**	**6**	**11**	**10**	**8**	**13**	**8**	**11**	**9**	**69**
Total stakeholders by industry		**16**		**19**			**21**			**18**		

* Note: some stakeholders were involved in multiple projects and industries, so stakeholder totals do not equal the sum of underlying stakeholders.

Appendix D. Survey and interview questions

The seven KEQs identified in the TOR were aligned to appropriate survey and interview questions based on the Mid-Term Evaluation (where appropriate, to provide consistency and continuity), as well as the Performance Indicators from the Program Logic Framework in the MEP (shown in Appendix H). Table D1 details the survey and interview questions, showing alignment the KEQs.

Not all M&E Performance Indicators were appropriate for survey and interview questions. Those Performance Indicators not directly tied to a survey and interview question instead informed a desktop review of program and project outputs. This approach ensured that all appropriate M&E Performance Indicators were addressed to understand the specifics of the research outcomes, with all information aggregating to be summarised against the KEQs.

The developed questionnaire was delivered through an online format (using Survey Monkey®). Follow up telephone interviews of approximately 30 minutes duration were undertaken with key stakeholders as appropriate for clarification or additional comment. Internal stakeholders (research staff and RDCs) received a full questionnaire across all KEQs, while external stakeholders received a reduced questionnaire excluding project planning and delivery questions (KEQ 5).

Table D1. Survey and interview questions, showing alignment the KEQs

KEQ	Q #	Question
0	1	Respondent name
0	2	Respondent role (select single most relevant):
		A) Research and Development Corporation (RDC)
		B) Research project leader
		C) Research project team member
		D) Research project partner
		E) Industry Programs/ Service Providers
		F) Producer / Grower
0	3	Related industry:
		A) Sugar
		B) Cotton
		C) Dairy
		D) Mango
		E) Cherry
0	4	Given the research project you have been involved with has now been completed, how satisfied are you with:
		(A) your specific project/activities? (rating 1=low, 5=high)
		(B) overall program progress to date? (rating 1=low, 5=high)

1	5	Overall, how much have the program/project activities contributed towards changes in knowledge and understanding of the factors which influence Nitrogen Use Efficiency (NUE) (rating 1=low, 5=high).
1	6	The following question relates to MPfN research on *the interplay of soil, weather, climatic and farm management factors to optimise nitrogen N formulation, rate and timing across industries, farming regions and irrigated/ non-irrigated situations (Activity B5 — optimising NUE in irrigated systems).* How much have the program/project activities contributed towards changes in knowledge and understanding of this area of research (rating 1=low, 5=high).
1	7	The following question relates to MPfN research on *the contribution (quantifying rate and timing) of mineralisation to a crop or pasture's N budget (Activity B6 — better understanding N supply through mineralisation).* How much have the program/project activities contributed towards changes in knowledge and understanding of this area of research (rating 1=low, 5=high).
1	8	The following question relates to MPfN research on *how enhanced efficiency fertiliser (EEF) formulations can better match a crop or pasture's specific N requirements (Activity B4 — extracting value from EEFs).* How much have the program/project activities contributed towards changes in knowledge and understanding of this area of research (rating 1=low, 5=high).
1	9	Please provide any comments regarding your answers to Qs 5–8 (MPfN contribution to changes in knowledge and understanding of NUE)
2	10	The following question relates to MPfN research on *the interplay of soil, weather, climatic and farm management factors to optimise nitrogen N formulation, rate and timing across industries, farming regions and irrigated/ non-irrigated situations (Activity B5 optimising NUE in irrigated systems).* How much have the program/project activities in the above research area contributed towards new or improved NUE resources (such as strategies, tools, and technologies) (rating 1=low, 5=high).
2	11	The following question relates to MPfN research on *the contribution (quantifying rate and timing) of mineralisation to a crop or pasture's N budget (Activity B6 — better understanding N supply through mineralisation).* How much have the program/project activities in the above research area contributed towards new or improved NUE resources (such as strategies, tools, and technologies) (rating 1=low, 5=high).
2	12	The following question relates to MPfN research on *how enhanced efficiency fertiliser (EEF) formulations can better match a crop or pasture's specific N requirements (Activity B4 — extracting value from EEFs).* How much have the program/project activities in the above research area has contributed towards new or improved NUE resources (such as strategies, tools, and technologies) (rating 1=low, 5=high).
2	13	Please provide any comments regarding your answers to Qs 10–12 (MPfN contribution to new or improved NUE resources)
3	14	To what extent do you think that the MPfN program will result in the greater producer confidence to apply the recommended NUE strategies relating to:
		A) Addressing significant N loss pathways for improved management of NUE on irrigated farms.
		B) The appropriate source, rate, timing and placement of N fertiliser.
		C) The potential for Enhanced Efficiency Fertilizers to better match a crops specific N requirements.

3	15	How confident are you, that adoption of the MPfN NUE strategies will result in more consistent profitability for primary producers and reduced negative environmental impact?
4	16	How would you rate the effectiveness of the following extension and external communication activities to disseminate relevant research project information? Please only rate those activities with which you were involved.
		A) Demonstrations/farm visits
		B) Field Days
		C) Workshops
		D) Conferences
		E) Industry magazine / newsletter articles
		F) Social media
		G) One on One farm visits
		H) Other, please specify.
4	17	For extension and external communication activities, please comment on what did, or did not work well and why.
4	18	Overall, how effective do you think the extension and communication activities have been at demonstrating industry opportunities for greater production and profit through increased Nitrogen Use Efficiency (NUE)?
4	19	Please provide any evidence to support your answers to question 18.
4	20	What examples can you provide where, as a result of MPfN project activities, primary producers and/or service providers are already starting to see or are on the way to seeing:
		A) Gains in profitability?
		B) Environmental impacts?
4	21	What issues / barriers have you identified that you expect will affect the speed or level of producer adoption of MPfN program outputs? And what could be done to minimise these?
5	22	Overall, how confident are you that MPfN's planning, monitoring and reporting instruments effectively support the delivery of research, communication and extension objectives?
5	23	Please provide any comments regarding your answers to question 22.
5	24	How would you rate the effectiveness of the following communication activities?
		A) Website for central sign-posting
		B) Articles in industry newsletters
		C) Information Sheet/MPfN Booklet - annual update
		D) Project Branding
		E) Templates for guidance
5	25	What issues or opportunities have arisen in your experience of MPfN to date that have impacted on the completion of activities or outputs and deliverables? (e.g. Budget/ industry issues/ resources/ research setup etc). And if relevant how have these been addressed?

5	26	How would you rate effectiveness of the following collaboration activities between MPfN program partners?
		A) Project Management Committee
		B) Annual Partner Forum
		C) Project Team Contact List
		D) Quarterly Nitrogen Natters Newsletter
		E) Webinar- N mineralisation measurement
		F) MPfN Program Booklet & Website
		G) Informal email conversations between leaders
		H) Collaborations facilitated by the Science Coordinator
5	27	While conducting your research activities, how effective have you found the support you've received from the:
		A) Science Coordinator
		B) Research and Development Corporation (RDC) Partners
		C) Project Manager (CRDC)
5	28	How satisfied are you that the MPfN communications plan, and assistance provided by the Science Coordinator, effectively supports your project/ industry to promote its research activities/ outcomes / potential benefits to producers?
6	29	What unexpected outcomes (positive or negative) are you aware of that resulted from MPfN activities (at all levels including program level, research projects, producers/service providers)? Please provide any examples.
7	30	What changes could have improved:
		A) Research and development effectiveness
		B) Extension effectiveness
		C) Adoption impact
7	31	Please make any other comments about the MPfN program

Appendix E. Document register

Table E1 provides a list of the key documents reviewed for the Final Evaluation.

Table E1. Key documents reviewed

MPfN document details
MPFN Program Management Agreement December 2016
MPFN Program Management Agreement Variation December 2017
MPfN CEP March 2017
MPfN MEP April 2017
MPfN PMP February 2017
MPfN M&E Database: 161 extension activities and outputs; 154 media communication activities and outputs; 46 project material outputs; 75 collaboration activities and outputs. As at April 2021.
MPFN Mid-Term Evaluation Survey Report August 2018
MPfN websites (CRDC, Dairy Australia, SRA, TIA, NT Gov)
MPfN Milestone Reports (x9), and supporting sub-project updates.
Nitrogen Natters quarterly newsletter (x15)
MPfN Program Booklet January 2018
MPfN Project Updates (1 per sub-project)
MPfN Final Reports (projects 1901, 1713, 1714, 1715, 1716, 1717, 1718)
MPfN Technical Reports (projects 1714, 1717)
MPfN project 1715 Mineralisation Calculator
Moody, PW, 2019, *Characterising the soil organic carbon and nitrogen pools and the mineralisable soil nitrogen at MPfN field trial sites*

Appendix F. MPfN Activities, outputs and KPIs

Table F1 shows the MPfN activities, outputs, KPIs, milestones as per the Deed of Variation (DoV) (Dec 2017) to the Commonwealth Grant Agreement (CGA), and the evaluated status of each.

Table F1. Evaluation of the MPfN activities, outputs, KPIs, milestones

Industry	Activity	Output	Output description	KPI	Milestone Due	Status
All	B1	1 (a)	Engage a project manager (Science Leader) for the duration of the Activity.	KPI 1.1 – Confirm engagement of a project manager (Science Leader)	30/11/2016	Achieved
All	B1	1 (b)	Establish a project management committee responsible for oversight of the Activity. The project management committee will agree its terms of reference which will set out its membership, governance arrangements and responsibilities.	KPI 1.2 – Provide the agreed membership, governance arrangements and terms of reference for the project management committee	30/11/2016	Achieved
All	B1	1 (c)	Execute agreements with partner organisations	KPI 1.3 – Provide a list of all partner organisations and the status of partner agreements, including the date signed or the date expected to be signed.	30/11/2016	Achieved
All	B1	1 (d)	Advise on the yearly breakdown of the cash and in-kind contributions to be provided by partner organisations for the duration of the Activity.	KPI 1.4 – Provide a list of cash and in kind contributions for each partner, for each financial year of the Activity and the total amount of funding and in kind contributions	30/11/2016	Achieved
All	B1	1 (e)	Establish appropriate industry steering / reference groups for each relevant industry.	KPI 1.5 – Provide a list of industry steering/reference groups established	30/11/2016	Achieved
All	B2	2 (a)	Prepare a project plan, setting out the schedule for activities, and the human resources and financial resources required. Prepare a risk management plan as part of the project plan.	KPI 1.7 – Provide a draft project plan.	30/11/2016	Achieved
All	B2			KPI 2.1 – Provide the project plan endorsed by the project management committee.	3/07/2017	Achieved
All	B2	2 (b)	Prepare a communication and extension plan, setting out the schedule for communication and extension activities, and the human resources and financial resources required.	KPI 2.2 – Provide the communication and extension plan.	3/07/2017	Achieved
All	B2	2 (c)	Prepare a monitoring and evaluation plan, setting out timeframes for activities to be delivered, and the human resources and financial resources required. The evaluation plan should address the Project's three key aims:	KPI 2.3 – Provide the monitoring and evaluation plan.	3/07/2017	Achieved

All	B2	2 (d)	Provide a progress report on the evaluation of the project, delivered at the mid-point of the project.	KPI 4.1 – Provide a mid-term evaluation report.	13/08/2018	Achieved
All	B2	E2	Final Report mandatory inclusions.	KPI 10.1 – Provide the final evaluation of the activity	30/09/2021	On track
All	B3	3 (a)	Identify target audiences and establish appropriate contacts with them, including peak industry bodies, growers in target regions, industry extension agents and crop consultants / agronomists.	KPI 2.4 – Provide an update on communication and extension activities	3/07/2017	Achieved
All	B3			KPI 3.1 – Provide an account of completed communication and extension activities	1/02/2018	Achieved
All	B3			KPI 4.2 – Provide an account of completed communication and extension activities	13/08/2018	Achieved
All	B3			KPI 5.1 – Provide an account of completed communication and extension activities	4/02/2019	Achieved
All	B3			KPI 6.1 – Provide an account of completed communication and extension activities	15/07/2019	Achieved
All	B3			KPI 7.1 – Provide an account of completed communication and extension activities	24/01/2020	Achieved
All	B3			KPI 8.1 – Provide an account of completed communication and extension activities	30/06/2020	Achieved
All	B3			KPI 9.1 – Provide an account of completed communication and extension activities	5/02/2021	Achieved
All	B3			KPI 10.2 – Provide a summary of completed communication and extension activities	30/09/2021	On track
All	B3	3 (b)	Implement the communication and extension plan and hold an annual project partners' forum. Promote project activities and outcomes at events that are expected to include: regional and national conferences, industry workshops, seminars and field days.	KPI 2.4 – Provide an update on communication and extension activities	3/07/2017	Achieved
All	B3			KPI 3.1 – Provide an account of completed communication and extension activities	1/02/2018	Achieved
All	B3			KPI 4.2 – Provide an account of completed communication and extension activities	13/08/2018	Achieved
All	B3			KPI 5.1 – Provide an account of completed communication and extension activities	4/02/2019	Achieved
All	B3			KPI 6.1 – Provide an account of completed communication and extension activities	15/07/2019	Achieved
All	B3			KPI 7.1 – Provide an account of completed communication and extension activities	24/01/2020	Achieved
All	B3			KPI 8.1 – Provide an account of completed communication and extension activities	30/06/2020	Achieved

All	B3	3 (b) (cont…)		KPI 9.1 – Provide an account of completed communication and extension activities	5/02/2021	Achieved
All	B3			KPI 10.2 – Provide a summary of completed communication and extension activities	30/09/2021	On track
All	B3	3 (c)	Prepare articles for publication in local media outlets and/or industry-specific magazines, newsletters, journals and websites; and prepare abstracts for presentation at industry-specific conferences. Publish research findings.	KPI 2.4- Provide an update on communication and extension activities	3/07/2017	Achieved
All	B3			KPI 3.1 – Provide an account of completed communication and extension activities	1/02/2018	Achieved
All	B3			KPI 4.2 – Provide an account of completed communication and extension activities	13/08/2018	Achieved
All	B3			KPI 5.1 – Provide an account of completed communication and extension activities	4/02/2019	Achieved
All	B3			KPI 6.1 – Provide an account of completed communication and extension activities	15/07/2019	Achieved
All	B3			KPI 7.1 – Provide an account of completed communication and extension activities	24/01/2020	Achieved
All	B3			KPI 8.1 – Provide an account of completed communication and extension activities	30/06/2020	Achieved
All	B3			KPI 9.1 – Provide an account of completed communication and extension activities	5/02/2021	Achieved
All	B3			KPI 10.3 – Provide a list of prepared, submitted and published research	30/09/2021	On track
All	B3	E1 (h)	A list of all planned or completed media, communications and extension activities or materials. Where appropriate, photographs of Activity work should be provided. Imagery should be high resolution (at least 5 megapixels), along with caption and credit information.	KPI 3.1 – Provide an account of completed communication and extension activities	1/02/2018	Achieved
All	B3			KPI 4.2 – Provide an account of completed communication and extension activities	13/08/2018	Achieved
All	B3			KPI 5.1 – Provide an account of completed communication and extension activities	4/02/2019	Achieved
All	B3			KPI 6.1 – Provide an account of completed communication and extension activities	15/07/2019	Achieved
All	B3			KPI 7.1 – Provide an account of completed communication and extension activities	24/01/2020	Achieved
All	B3			KPI 8.1 – Provide an account of completed communication and extension activities	30/06/2020	Achieved
All	B3			KPI 9.1 – Provide an account of completed communication and extension activities	5/02/2021	Achieved

Sugar	B4	4 (a)	'Next generation fertiliser formulation': investigate sorption and desorption processes. This may include diffusion and kinetics studies relative to the rates of plant uptake and competing processes; undertaking laboratory studies on optimising inhibitor protection; and screening trials for formulations and rainfall simulation.	KPI 2.5 – Provide an update on 'Next generation fertiliser formulation' sorption and desorption process investigations.	3/07/2017	Achieved
Sugar	B4	4 (a)	'Next generation fertiliser formulation': investigate sorption and desorption processes. This may include diffusion and kinetics studies relative to the rates of plant uptake and competing processes; undertaking laboratory studies on optimising inhibitor protection; and screening trials for formulations and rainfall simulation.	KPI 2.5b – Provide an update on 'Next generation fertiliser formulation' sorption and desorption process investigations.	1/02/2018	Achieved
Sugar	B4			KPI 2.5c – Provide an update on 'Next generation fertiliser formulation' sorption and desorption process investigations.	4/02/2019	Achieved
Sugar	B4	4 (b)	'Next generation fertiliser formulation': establish small plot fertiliser and inhibitor field trials, employing valid factorial or partial factorial design.	KPI 4.3 – Provide an update on 'Next generation fertiliser formulation' fertiliser and field trials outcomes.	24/01/2020	Achieved
Sugar	B4	4 (c)	'Next generation fertiliser formulation': evaluate nutrient capture using replicated rainfall and simulation. This may include flume evaluation using a statistically valid design and enhanced filter strips studies using a statistically valid design.	KPI 4.4 – Provide an update on the evaluation of nutrient capture.	24/01/2020	Achieved
Sugar	B4	4 (d)	'Next generation fertiliser formulation': establish field trials (at least two sites) to integrate agronomic measures and key loss pathways, including identifying links to other key research teams and using mathematical modelling to tailor the fertiliser formulations to crop requirements.	KPI 6.2 – Provide an account of established 'Next generation fertiliser formulation' field trials.	30/06/2020	Achieved
Sugar	B4	4 (e)	'Next generation fertiliser formulation': construct the apparatus to manufacture formulations for field trial and estimate the cost of manufacturing the formulation.	KPI 6.3 – Provide brief commentary on the construction of a formulation manufacturing apparatus and related cost.	30/06/2020	Achieved
Sugar	B4	4 (f)	'Next generation fertiliser formulation': identify products that can decrease vulnerability to leaching, and stabilise nitrogen transformations.	KPI 8.4 – Provide a brief and final account of the identification of products that decrease vulnerability to leaching and the stabilisation of nitrogen transformations.	30/09/2021	On track
Sugar	B4	4 (g)	'Smart Blends': conduct field trials in four to five cane regions to investigate the optimum combination(s) of fertiliser blending ratio and fertiliser application rate.	KPI 2.6 – Provide an update on 'Smart Blends' experiments	3/07/2017	Achieved
Sugar	B4			KPI 4.5- Provide an update on 'Smart Blends' experiments	13/08/2018	Achieved
Sugar	B4			KPI 6.4 – Provide an update on 'Smart Blends' experiments	15/07/2019	Achieved

Sugar	B4	4 (g) (cont…)		KPI 8.5 – Provide a brief and final account of the 'Smart Blends' experiments.	30/06/2020	Achieved
Sugar	B4	4 (h)	'Deep soil Nitrogen': draft a technical report for the use of EEFs in cane at the two year growth mark; and estimates to calculate soil and fertiliser nitrogen (N) supply. Report findings and agro-economic modelling at an industry workshop.	KPI 4.6 – Provide brief commentary on the planning for a sugar industry EEFs workshop.	15/07/2019	Achieved
Sugar	B4	4 (h)	'Deep soil Nitrogen': draft a technical report for the use of EEFs in cane at the two year growth mark; and estimates to calculate soil and fertiliser nitrogen (N) supply. Report findings and agro-economic modelling at an industry workshop.	KPI 6.5- Provide brief commentary regarding the drafting of a technical report for the use of EEFs at the sugar industry workshop.	30/06/2020	Achieved
Horticulture	B4	4 (i)	Next generation fertiliser formulation': conduct fertigation (irrigation by fertilisation) trials using biologicals or EEFs.	KPI 2.7 – Provide an update on the outcome of the fertigation trials.	3/07/2017	Achieved
Horticulture	B4			KPI 2.7b – Provide an update on the outcome of the fertigation trials.	13/08/2018	Achieved
Horticulture	B4	4 (j)	Conduct experiments to assess fruit quality and productivity under EEF (mangos)/biological (cherries) fertiliser treatments.	KPI 4.7 – Provide an update on the results from fruit quality and productivity experiments.	15/07/2019	Achieved
Horticulture	B4	4 (k)	Evaluate the best performing EEF (mangos)/biological fertiliser (cherries) from the experiments conducted in Output 4(j).	KPI 6.6 – Provide an update on the evaluation of best performing EEFs in mango and cherry crops.	30/06/2020	Partially achieved
Horticulture	B4			KPI 8.6 – Provide a brief and final account of the evaluation of best performing EEFs in mango and cherry crops.	30/09/2021	On track
Horticulture	B4	4 (l)	Develop recommendations for the timing, rate and placement of EEFs and any potential EEF blends to reduce nitrogen losses; and optimise Nitrogen Use Efficiency (NUE) both at a plot and farm scale level.	KPI 8.7 – Provide the department with the EEF recommendations and a brief account of optimising NUE at both plot and farm-scale level.	30/09/2021	On track
Dairy	B4	4 (m)	Test different EEF blends at two locations in NSW, (likely Casino and Camden, to: identify optimal timing of different EEF; any potential EEF blends to reduce nitrogen losses; and optimise NUE	KPI 4.8 – Provide an update on the EEF blend test outcomes in NSW	4/02/2019	Achieved
Dairy	B4			KPI 6.7 - Provide an update on the EEF blend test outcomes in NSW	24/01/2020	Achieved
Cotton	B5	5 (a)	Conduct cotton experiments on the core research site at Narrabri to investigate fertiliser by irrigation interactions.	KPI 2.8 – Provide an update on cotton experiments at the core research site, and planning for satellite sites.	3/07/2017	Achieved
Cotton	B5			KPI 4.9 – Provide an update on cotton experiments at the satellite and core research sites	13/08/2018	Achieved

Cotton	B5	5 (a) (cont…)		KPI 6.8 – Provide an update on cotton experiments at the satellite and core research sites	15/07/2019	Achieved
Cotton	B5			KPI 8.8 – Provide an update on cotton experiments at the satellite and core research sites	30/06/2020	Achieved
Cotton	B5			KPI 10.4 – Provide a complete and final account of cotton experiments at the satellite and core research sites	30/09/2021	On track
Cotton	B5	5 (b)	Conduct cotton experiments on two satellite sites, informed by findings of Output 5(a) and any	KPI 2.8 – Provide an update on cotton experiments at the core research site, and planning for satellite sites.	3/07/2017	Achieved
Cotton	B5	5 (b)	Conduct cotton experiments on two satellite sites, informed by findings of Output 5(a) and any specific local influences or factors.	KPI 4.9 – Provide an update on cotton experiments at the satellite and core research sites	13/08/2018	Achieved
Cotton	B5			KPI 6.8 – Provide an update on cotton experiments at the satellite and core research sites	15/07/2019	Achieved
Cotton	B5			KPI 8.8 – Provide an update on cotton experiments at the satellite and core research sites	30/06/2020	Achieved
Cotton	B5			KPI 10.4 – Provide a complete and final account of cotton experiments at the satellite and core research sites	30/09/2021	On track
Horticulture	B5	5 (c)	Conduct N15 research trials under irrigation in mango and cherry crops.	KPI 2.9 – Provide an update on N15 research trials and NUE in horticulture tree crops.	3/07/2017	Achieved
Horticulture	B5			KPI 2.9b – Provide an update on N15 research trials and NUE in horticulture tree crops.	13/08/2018	Achieved
Horticulture	B5			KPI 4.10 – Provide an update on N15 research trials and NUE in horticulture tree crops	15/07/2019	Achieved
Horticulture	B5			KPI 6.9 – Provide an update on N15 research trials and NUE in horticulture tree crops.	30/06/2020	Achieved
Horticulture	B5	5 (d)	Determine seasonal and inter-annual cherry and mango plant nitrogen (N) demand, quantify N losses, uptake and calculate NUE.	KPI 8.9 – Provide a brief and final account of calculating NUE for cherry and mango nitrogen use.	30/09/2021	On track
Horticulture	B5	5 (e)	Develop and test algorithms for remote sensing of leaf N content (mangos) based on the results of Outputs 5(c) and 5(d).	KPI 8.10 – Provide a brief and final account of the developed and tested algorithms for remote sensing of leaf N content.	30/09/2021	On track
Horticulture	B5	5 (f)	Develop NUE benchmarks for the horticulture industry to target.	KPI 8.11 – Provide a brief and final account of the NUE benchmarks developed for the horticulture industry.	30/09/2021	On track
Dairy	B5	5 (g)	Conduct N15, N loss and irrigation trials on irrigated dairy farms at two locations in NSW (Casino and Camden)	KPI 2.10 – Provide an update on N15, N loss and irrigation trials in NSW.	3/07/2017	Achieved
Dairy	B5			KPI 2.10b – Provide an update on N15, N loss and irrigation trials in NSW.	1/02/2018	Achieved

Dairy	B5	5 (g) (cont…)		KPI 4.11 – Provide an update on N15, N loss and irrigation trials in NSW.	4/02/2019	Achieved
Dairy	B5	5 (h)	Determine the impact irrigation management has on soil N processes and losses on dairy farming systems and calculate agronomic efficiency of N and water use.	KPI 2.10 – Provide an update on N15, N loss and irrigation trials in NSW	3/07/2017	Achieved
Dairy	B5			KPI 2.10b – Provide an update on N15, N loss and irrigation trials in NSW.	1/02/2018	Achieved
Dairy	B5			KPI 4.11 – Provide an update on N15, N loss and irrigation trials in NSW	4/02/2019	Achieved
Dairy	B5	5 (i)	Undertake whole farm systems modelling of interactions between water and N application and soil N mineralisation.	KPI 2.11 – Provide commentary on the outcomes to date of whole farm system modelling at both a systems and component level	3/07/2017	Achieved
Dairy	B5			KPI 4.12 – Provide commentary on the outcomes to date of whole farm system modelling at both a systems and component level	13/08/2018	Achieved
Dairy	B5	5 (j)	Identify best combinations of irrigation, fertiliser timing and EEF type and development of NUE Best Management Practices (BMPs) for the dairy industry. This may include integrating mineralisation algorithms into N decision tools; and modelling the practicality, cost-effectiveness and adoptability of dairy nitrogen management practices.	KPI 2.11 – Provide commentary on the outcomes to date of whole farm system modelling at both a systems and component level	3/07/2017	Achieved
Dairy	B5			KPI 4.12 – Provide commentary on the outcomes to date of whole farm system modelling at both a systems and component level	13/08/2018	Achieved
Dairy	B5			KPI 4.13 – Provide commentary on the development of Best Management Practices for the dairy industry and the outcome of sharing these findings at workshops and field days.	4/02/2019	Achieved
Dairy	B5			KPI 6.10 – Provide commentary on the development of Best Management Practices for the dairy industry and the outcome of sharing these findings at field days.	24/01/2020	Achieved
Dairy	B5	5 (k)	Conduct field days at each trial site for dairy farmers demonstrating project findings	KPI 4.13 – Provide commentary on the development of Best Management Practices for the dairy industry and the outcome of sharing these findings at workshops and field days.	4/02/2019	Achieved
Dairy	B5			KPI 6.10 – Provide commentary on the development of Best Management Practices for the dairy industry and the outcome of sharing these findings at field days	24/01/2020	Achieved
Cotton	B6	6 (a)	Conduct a cotton field mineralisation experiment in Queensland and take samples at key crop growth phases.	KPI 3.2 – Provide an update on cotton field mineralisation experiments in Queensland.	1/02/2018	Achieved

Cotton	B6	6 (a) (cont…)		KPI 5.2 – Provide an update on cotton field mineralisation experiments in Queensland.	4/02/2019	Achieved
Cotton	B6	6 (b)	Investigate the potential impact of long-term phosphorous (P) decline and/or stratification on the nitrogen cycle in cotton farming systems.	KPI 3.3 – Provide an update on investigations into the potential impact of long-term P decline and/or stratification on the nitrogen cycle in cotton farming systems.	1/02/2018	Achieved
Cotton	B6			KPI 5.3 – Provide an update on investigations into the potential impact of long-term P decline and/or stratification on the nitrogen cycle in cotton farming systems.	4/02/2019	Achieved
Cotton	B6	6 (b)	Investigate the potential impact of long-term phosphorous (P) decline and/or stratification on the nitrogen cycle in cotton farming systems.	KPI 7.2 – Provide an update on investigations into the long-term P decline and/or stratification on the nitrogen cycle in cotton farming systems.	24/01/2020	Achieved
Cotton	B6			KPI 8.12 – Provide an update on investigations into the potential impact of long-term P decline and/or stratification on the nitrogen cycle in cotton farming systems.	30/06/2020	Achieved
Cotton	B6			KPI 10.5 – Provide a brief and final account of the investigations into the potential impact of long-term P decline and/or stratification on the nitrogen cycle in cotton farming systems.	30/09/2021	On track
Horticulture	B6	6 (c)	Quantify the timing and amount of N released in tree crop residues.	KPI 3.4 – Provide an update on the investigations to quantify the timing and amount released in mango crop residues.	13/08/2018	Achieved
Horticulture	B6			KPI 5.4 – Provide an update on the investigations to quantify the timing and amount of N released in tree crop residues.	15/07/2019	Achieved
Horticulture	B6			KPI 7.3 – Provide an update on the inestigations to quantify the timing and amount of N released in tree crop residues.	30/06/2020	Achieved
Horticulture	B6			KPI 8.13- Provide a brief and final account of the investigations to quantify the timing and amount of N released in mango crop residues.	30/09/2021	On track
Horticulture	B6	6 (d)	Quantify the N mineralisation from soil organic matter (SOM) in key cherry and mango soils.	KPI 8.14 – Provide a brief and final account of quantifying N mineralisation from soil organic matter.	30/09/2021	On track

Sugar	B6	6 (e)	'Deep soil N': conduct sampling and analysis of up to 30 cane paddocks in Queensland and NSW to determine deep soil N content / mineralisable N (supply of N by soil).	KPI 3.5 – Provide an update on 'Deep soil N' experiments.	13/08/2018	Achieved
Sugar	B6	6 (f)	'Deep soil N': conduct incubations to estimate mineralisable N in the same locations as outlined in Output 6(e).	KPI 3.5 – Provide an update on 'Deep soil N' experiments.	13/08/2018	Achieved
Sugar	B6			KPI 5.5 – Provide an update on 'Deep soil N' experiments.	15/07/2019	Achieved
Sugar	B6	6 (g)	'Deep soil N': conduct experiments on three field trial sites (including micro-plots) in Northern NSW cane sites for N fertiliser rates response investigations. Data to be collected includes crop yield, crop biomass/N15 uptake and leaching levels.	KPI 3.5 – Provide an update on 'Deep soil N' experiments.	13/08/2018	Achieved
Sugar	B6			KPI 5.5 – Provide an update on 'Deep soil N' experiments.	15/07/2019	Achieved
Sugar	B6	6 (g)	'Deep soil N': conduct experiments on three field trial sites (including micro-plots) in Northern NSW cane sites for N fertiliser rates response investigations. Data to be collected includes crop yield, crop biomass/N15 uptake and leaching levels.	KPI 7.4 – Provide a brief and final account of the 'Deep soil N' experiments and the definition of N response curves for farm scale N stocks.	5/02/2021	Achieved
Sugar	B6	6 (h)	'Deep soil N': define N response curves for farm-scale N stocks (mineralisable and deep soil N) for cane at two year growth mark; develop equations for mineralisable N against Near Infra Red/Mid Infra Red methodologies; and develop a standard operating practice for commercial application.	KPI 5.5 – Provide an update on 'Deep soil N' experiments.	15/07/2019	Achieved
Sugar	B6			KPI 7.4 – Provide a brief and final account of the 'Deep soil N' experiments and the definition of N response curves for farm scale N stocks.	5/02/2021	Achieved
Dairy	B6	6 (i)	Identify, establish and monitor zero N and N15 plots for apparent and total N recoveries in irrigated dairy systems at two locations in NSW (Casino and Camden)	KPI 3.6 – Provide an update on the N experiments on irrigated dairy farms in NSW.	13/08/2018	Achieved
Dairy	B6			KPI 5.6 – Provide an update on the N experiments on irrigated dairy farms in NSW.	15/07/2019	Achieved
Dairy	B6	6 (j)	Establish technical reference groups and hold field days, workshops and knowledge exchange for the dairy industry including one workshop to refine a N mineralisation RD&E program.	KPI 1.6 – Provide brief commentary on dairy workshop and knowledge exchange preparations	30/11/2016	Achieved
Dairy	B6			KPI 3.7 – Provide brief commentary on the planning for the technical reference groups, field days and workshops	13/08/2018	Achieved
Dairy	B6			KPI 5.10 – Provide an update on the development of the mineralisation calculator, the workshop to refine the mineralisation RD&E program and the planning for a dairy workshop to demonstrate the mineralisation calculator.	15/07/2019	Achieved
Dairy	B6			KPI 5.7 – Provide brief commentary on technical reference groups established, field days held and the outcomes of the dairy knowledge exchange workshops held.	15/07/2019	Achieved

Dairy	B6	6 (j) (cont…)		KPI 7.5 – Provide brief and final commentary on the technical reference groups established, field days held and the outcome of the dairy knowledge exchange workshops.	24/01/2020	Achieved
Dairy	B6	6 (k)	Conduct field trials to determine N dynamics rain-fed and irrigated dairy systems in south west Victoria; and to predict N cycling and losses. This includes isolation of key drivers of mineralisation and testing mineralisation prediction mechanisms once sufficient data is generated.	KPI 3.8 – Provide an update on the N experiments on irrigated and rain-fed dairy farms in south west Victoria	13/08/2018	Achieved
Dairy	B6			KPI 5.8 – Provide an update on the N experiments on irrigated and rain-fed dairy farms in south west Victoria	15/07/2019	Achieved
Dairy	B6			KPI 7.6 – Provide a brief and final account on the N experiments on irrigated and rain-fed dairy farms in south west Victoria.	24/01/2020	Achieved
Dairy	B6	6 (l)	Conduct laboratory studies on nitrogen and nitrous oxide emissions to inform field findings from Output 6(k).	KPI 3.8 – Provide an update on the N experiments on irrigated and rain-fed dairy farms in south west Victoria	13/08/2018	Achieved
Dairy	B6	6 (l)	Conduct laboratory studies on nitrogen and nitrous oxide emissions to inform field findings from Output 6(k).	KPI 5.9 – Provide brief commentary on laboratory study outcomes.	15/07/2019	Achieved
Dairy	B6	6 (m)	Develop a mineralisation calculator and convene a workshop for dairy farmers demonstrating the findings and the mineralisation calculator.	KPI 5.10 – Provide an update on the development of the mineralisation calculator, the workshop to refine the mineralisation RD&E program and the planning for a dairy workshop to demonstrate the mineralisation calculator.	15/07/2019	Achieved
Dairy	B6			KPI 7.7 – Provide brief and final commentary on the development of the mineralisation calculator and the dairy workshop held to demonstrate it.	24/01/2020	Achieved

Appendix G. Evaluation of delivery against MPfN Communication and Extension Plan tools

Appendix G details the evaluation of delivery against individual tools within the MPfN Communication and Extension Plan (CEP). An evaluation was undertaken for each of the planned internal (Table G1) and external (Table G2) communication and extension tools.

Delivery of the planned communication and extension tools have been evaluated based off a combination of document review (were the communication and extension tools delivered as identified) and stakeholder engagement (did stakeholders view the tools as effective). The tools have been evaluated based on a three colour system with green reflecting strong performance, yellow showing moderate performance, and red showing weak performance.

Table G1. MPfN Communication and Extension Plan — evaluation of internal tools

Communication tool	Purpose	Planned Audience	Planned Frequency	Evaluation (colour) and comment
Program Management Committee (PMC)	Oversee implementation and monitoring of the communication & extension plan.	Sector partners	At least twice annually at PMC meetings. Each year: Q2 & Q4	• 9 PMC meetings held to date.
	Information exchange on strategic communication strategies and adherence with Commonwealth Grant Agreement requirements.	Research partners		
Science Coordinator	Establish an appreciation and understanding between partners of the cross-sector and cross-project sharing and learning conduits offered by the project with an aim to increase Program efficiencies, reduce duplication of effort and create new opportunities for the current and future collaborative projects.	Sector partners	Ongoing	• Internal stakeholders rated the science coordinator as highly effective in supporting internal collaboration and communication activities between MPfN program partners (average rating 4.3, n=23).
		Research partners		
		Project collaborators		
Program partner forums	Provide forum for updates on Program progress and delivery and opportunity for representatives from sector partners, research partners and project collaborators to raise strategic issues for the PMC to consider and Science Coordinator to action.	Sector partners	Annually Approximate: December 2016 August 2017 September 2018 July 2019 December 2019	• Partner Forums held in 2017, 2018, 2019, and 2020 (online due to COVID disruption), and 1 partner forum planned after this report (2021).
	Provide a platform for robust partner and cross sector exchange of information. The opportunity to discuss, share and debate allows research partners to identify synergies between partner activities, resulting in reduced duplication and improved Program outcomes which have multi sector relevance.	Research partners		
		Project collaborators		

Research project steering committees	Provide guidance, input and feedback to specific research projects, including communication and extension activities. Note: Not all research projects have committed to forming steering committees.	Research lead agency representatives Project Collaborators Farm advisors Industry program extension representatives Farmer/ industry group representatives	As specified in research partner communication & extension plan tables (Appendix C of CEP)	• Held for QUT, UTAS/TIA, QDES, NSWDPI.
Dairy Industry Forums	Knowledge exchange for the dairy industry and technical reference group for N mineralisation RD&E projects.	Dairy Australia Dairy research partner teams	Annual	• Multiple annual dairy industry collaborations in the development of industry resources.
Program partner e-newsletter	Technical knowledge exchange between the extended research project teams and progress updates. To be coordinated and prepared by the Science Coordinator. Hosted on CRDC MPfN Program webpage. Contributions to be made from all research partners and project contributions on project progressive findings and activities, including sharing tips and recommendations.	Sector partners Research partners & research peers Project collaborators Industry extension program staff	Quarterly Each year: March June September December	• 15 Nitrogen Natters e-newsletters completed (100% of planned).
Partner webinars/ professional development	General and specific technical knowledge exchange/ development platform for the 10 project research teams. These sessions are aimed at highlighting one or two of the projects in-depth and also inviting external researchers/ experts to upskill the researchers on identified emerging methodology or findings of aligned research (both national & international).	Sector partners Research partners	Quarterly Each year as identified & assisted by the research partners.	• Two online workshops held but in discussion with project leaders it was decided there were insufficient topics that covered the interest of all teams at that frequency. Professional development was incorporate into annual forums instead, which included guest speakers/ skills development sessions.
Email	The main vehicle for notifications and requests for information amongst Program stakeholders. An email tree approach has been agreed whereby the Science Coordinator will email sector & research partner primary contacts only, for further distribution to the research teams/ research collaborators as deemed appropriate.	Appendix A- Notification Distribution List.	Ongoing	• Internal stakeholders rated internal email use as a highly effective means of collaboration (average rating 3.9, n=22).
Workshops	Certain research projects will be conducting professional development training on specific modelling tools and calculators for extension to their relevant industries. These workshops will also be open to researchers from MPfN Program sectors so that the technology and extension learnings can be shared and potentially transferred to other sectors.	Sector partners Research partner teams Project collaborator teams Industry extension program staff	Primarily annually As scheduled by RP (Appendix C of CEP)	• 60 industry workshops held (273% of planned) across all industries.

Table G2. MPfN Communication and Extension Plan — evaluation of external tools

Tool	Purpose	Audience	Frequency	
Science Coordinator	Responsibility for communicating and extending the technical research and production/profit/ environmental advancements being investigated and achieved through the collaborative approach of the MPfN Program.	All audiences identified as external in Table 1.	Ongoing via presentations, meeting attendance, field day attendance, conference proceedings.	• Internal stakeholders were highly satisfied that the CEP, and assistance provided by the Science Coordinator, effectively supported the projects / industries to promote research outcomes to producers (average rating 4.2, n=30).
	Responsibility for communicating and extending the plain English intra and inter sector learning and practice outcomes of the MPfN Program to producers and service providers. These will be focused upon optimising NUE through:			
	o Efficient irrigation practices;			
	o Managing N fertiliser vs mineralisation;			
	o EEFs;			
	o Developing new products and optimising existing products; and			
	o Testing current, and developing new, Nitrogen Best Management Practices (BMPs)			
Website Pages	1) A simple MPfN Program page will be established on the existing CRDC website to provide a centralised portal for Program information and sign-posting for project specific information.	- External agencies and commercial companies - Media outlets - Potential Program collaborators - Industry specific stakeholders - Industry specific farmers & service providers - Potential research project collaborators - Industry extension staff	Project Duration Live Website Page- May 2017 Live partner webpages- July 2017	• MPfN Program webpage established as planned. • MPfN sector partner organisation webpages established as planned. • 29 website content activities reported across all industries as part of media communications. • Final website update being undertaken with final project outputs and updates.
	2) Each of the sector partner organisations will be encouraged to host a dedicated web page on their relevant industry website (See Appendix A) for the research projects of their sector. These may include:			
Industry Extension Programs	- Integration of research findings and outcomes into new and existing industry best practice NUE & WUE materials, resources and programs. - Extension of key production, profitability and environmental benefit messages associated with adoption of NUE practices, including use of developed tools and resources.	- Industry extension staff - Industry specific farmers & service providers - Nutrient and irrigation advisors.	Resources updated upon release of research outcomes As scheduled by RP (Appendix A of CEP) to deliver upon MPfN Program Outputs.	• New or updated industry resources for all industries (see Resource Materials / Tools on p5 of Annex G).

Social Media	Many project partners have existing Facebook, Twitter and Instagram pages which will be utilised to promote Program & project achievements, research findings, updates, activities, forums and meetings and share relevant links to websites. Utilising existing accounts, by providing content to project partner communications teams, ensures that existing audiences already engaged with those pages are communicated with effectively. Dedicated MPfN Program accounts would not have the content volume required to satisfy followers (at least 4 updates weekly). In addition, other industry networks such as farmers groups and commercial companies also have existing pages for which content could be prepared.	Existing and new partner social media followers	Ongoing Social media availability stocktake- April 2017 Social media protocols agreed & approved- June 2017 Ongoing content preparation	• 15 communication and extension activities identified as specifically social media (all videos with distribution across Facebook, twitter, Instagram, and YouTube). However, it is noted that many other communications activities would likely include a social media aspect, including through industry social media external to the MPfN program with reduced oversite or ability to track.
Industry Circulars (magazines, e-newsletters, newsletters, email campaigns)	Existing key industry communication channels will be used to engage industry audiences in the progress and findings of individual projects, overall MPfN Program progress and achievements and key NUE practice change messages.	Sector communication & media teams	Quarterly presence in at least 2 circulars for each industry (32)	• 78 industry circulars to date (244% of planned).
	Articles will be prepared by sector & research partner communication teams (project specific) and by the Science Coordinator (MPfN Program). Emails may be compiled for distribution to distribute information on key events.	Industry extension staff	Events promoted as planned	
		Industry specific farmers & service providers	Publications: Quarterly Magazines Fortnightly e-newsletters Preparation of material will coincide with publication dates with an aim to present MPfN Program information for each industry 8 times per year (32 total). As scheduled by RP (Appendix C of CEP)	
		Nutrient and irrigation advisors (private & commercial)		
		Private farm business consultants		

Media Releases	MPfN Program research project achievements, outcomes and implications for agricultural production, environmental impact and community benefits.	General media outlets- food & fibre markets (television news, print, radio)	Program achievements- 4 annually	• 7 General media communications across all industries (44% of planned) including 6 agriculture specific media (75% of planned). • 19 media and communication activities providing updates on research activity achievements (95% of planned media on project progress findings).
	Promotion of cross sector advantages of participating in a collaborative Program, including translatable/ transferable outcomes to reduce duplication of effort across industries.	Agricultural specific media outlets (television news, print, radio)	Program findings/ outcomes- 2018 x 3, 2019 x 3, 2020 x 2	
	Releases will feature quotes from partners, investors, service providers and farmers as appropriate to the topic. Will include photo, video footage and interview opportunities.	Sector communication & media teams	Project progress & findings- two per research project annually (20)	
	Releases will be prepared in collaboration with Sector & research partner communication and media teams as applicable.	Research organisation communication & media teams	Promotion & coverage of Program/ project events- annually	
	Partner spokespersons will be briefed on communication protocol requirements should an "on the spot" interview be requested.		Project overview and awareness raising, April 2017 Monthly commencing April 2017 For partner: As per event requirements	
Program Booklet	Provide an overview of the MPfN Program goals, participating partners/ collaborators and insight into the aims, methodology and contacts of the 10 research projects. This high level publication is designed to stimulate audience interest in engaging further in the Program/ project activities. The Program Booklet provides flexibility for the partners in that it can be presented as a collective publication or can be segregated into individual project research pages. The Program Booklet is designed to be downloadable from websites or printed in hand-out format for use at communication and extension events.	All media outlets	Prepared 2017 & updated annually Program Booklet ready for distribution 10th February 2017. Annual update undertaken January	• Prepared in January 2017, updated January 2018. Not subsequently updated as it was identified that this was not a key resources for stakeholders, and updates would be more effective at the project level.
		Researchers		
		Service Providers		
		Industry extension staff		
		Nutrient and irrigation advisors (private & commercial)		
		Farmers		

Communication Templates	Create an identifiable image for the MPfN Program and develop an easy to use method for preparing/ presenting event flyers and press releases for the partners of the Program.	Research Partners	Ongoing- per event/ press release	• Communication templates provided for researchers and research partners.
	The MPfN Program templates will provide a format in which the MPfN "brand" and Commonwealth acknowledgement obligations are ready installed within the document. The partners will be required to infill the relevant promotional/ communication text and logos only.	Event audiences & media outlets		
Resource material/ tools	All research projects will either prepare new resource material for industry extension programs or contribute to updating or amending current resources.	Service Providers	At least one resource material/ tool prepared for industry extension per research project (10) As scheduled by RP (Appendix C of CEP)	• Industry resources delivered to date and ongoing for 8 research projects: – Cotton (1712) Cotton Production Manual update. – Dairy (All) Fert$mart Nitrogen Guidelines and NUE Pocket Guide. – Dairy (1716) industry Mineralisation Calculator. – Sugarcane (1717) Six Easy Steps N budgeting model – Sugarcane (1718) Smart Blending booklet. – Mango (1720) BMPs – Cherry (1721) Recommended practice factsheet • No industry resources identified for project(s): – Cotton (1713) – Sugarcane (1719)
		Industry extension staff		
	Resources are designed to enhance the confidence of farmers to adopt best practices for NUE by providing science based facts & evidence, advising on practice options for their farm and promoting the business performance benefits in changing current practice.	Nutrient and irrigation advisors (private & commercial)		
	Resources will be prepared in collaboration with industry extension programs. Distribution will be through existing Industry extension program channels- websites, processors, farm visits, events	Farmer Groups		
		Individual Farmers		
Field Days/ Walks/ Workshops	MPfN Program activities and outcomes, including the benefits for the relevant industry of participating in cross sector collaborations.	Farmers	As specified in the KPIs of individual research projects.	• 34 field days / walks held across all industries (179% of planned). • 60 workshops held to date across all industries (273% of planned). • 13 Farmer discussion groups held across all industries (186% of planned). • 5 industry training events held across all industries (500% of planned).
	Farmer & service provider participatory learning, input and feedback opportunities into individual research trials or development of tools.	Nutrient and irrigation advisors (private & commercial).	Each project will use key milestones within research activities to engage with potential adopters to seek input and feedback.	

Field Days/ Walks/ Workshops **(continued)**	Demonstration to trial outcomes in real life scenarios.	Private farm business consultants	2019/2020 emphasis will be on advocating benefits of adopting research outcomes.	(See above)
	Communication of research findings and resultant recommendations for optimal N fertiliser formulations, timing, placement and rates, including associated irrigation management.	Service Providers	As scheduled by RP (Appendix C of CEP)	
	Skill development in use of decision support tools (ie. mineralisation calculator), BMP guidelines and industry benchmarks.	Industry extension staff		
Technical Forums	Conduit for open discussion on specific technical knowledge/ resource gaps and industry needs relating to particular areas of NUE or associated support topics ie. modelling, EEFs, sensor technologies.	Sector partners	As need is identified- potential for 1 annually As scheduled by RP (Appendix C of CEP) or as deemed beneficial to the program outputs by PMC.	• The PMC decided to incorporate technical forums into annual Partner Forums, which included attendance by Fertiliser Australia and other industry stakeholders.
	Research partners have identified that the MPfN Program may provide the conduit required to bring together key stakeholders on particular areas of technical need/ investigation, including potential investors.	Research partners Project Collaborators Service Providers Advisors Public/ private technology developers Early adopting farmers		
Videos/ Case Studies	Communication of need for research into NUE and overview/ progress of research project methodology and hypothesis.	Farmers Nutrient and irrigation advisors (private & commercial). Private farm business consultants Service Providers	Per research project: - 1 project overview video. - 1 video/ printable farm case study - Research project overviews by Dec 2017 - One Collaboration Case Study per year - 1 Case Study per RP by December 2019	• 1 project overview video completed as planned. • 9 video case studies completed across sugar, dairy, cotton, cherries. • 13 intra-industry collaborative economic case studies completed (4 for dairy, 2 each for other industry groups), and an additional case study on long term economic impacts. • Final videos being developed for each project as of June 2021.
	Extension of key production, profitability and environmental benefit messages associated with adoption of NUE practices, including use of technology and resources developed by the MPfN Program.			
	Resources will be prepared in collaboration with industry extension programs and farmers hosting trial sites. Distribution will be through existing Industry extension program websites.			

Research interim & final technical reports	Communication of research progress and findings of a technical nature.	Full Reports:	As per contracted KPIs as scheduled by CEP (Appendix C of CEP)	• Final and technical reports submitted and accepted to date: – Cotton (1713) – Dairy (1714) – Dairy (1715) – Dairy (1716) – Sugarcane (1717) – Sugarcane (1718) – All industries (1901) • Final and technical reports ongoing: – Cotton (1712) – Sugarcane (1719) – Cherry (1721) – Mango (1720)
	Distribution methodology will be decided with sector and research partners on a report by report basis. Report plain English summaries may be provided for broader distribution through industry networks.	Sector partners		
		Research partners		
		Researchers		
		Project Collaborators		
		Summaries:		
		Service Providers		
		Advisors		
		Public/ private technology developers		
		Early adopting farmers		
Conferences	Promotion of MPfN Program activities and outcomes, especially the benefits of cross sector collaboration effort via proceedings, presentation and posters.	Australian Government	Emphasis in 2018-2020	• 33 conferences held across all industries (194% of planned).
		National and international researchers	MPfN Program- 2018 x 2, 2019 x 2, 2020 x 2	
	Communication on project research findings and outcomes via proceedings, presentation and posters.	Industry program developers/ funders	As specified in research partner communication & extension plan tables (Appendix C of CEP)	
	Demonstration of new technologies and decision support tools via proceedings, presentation and posters.	Commercial product/ service developers	As deemed beneficial to the Program outputs.	
		Early farm adopters/ innovators		
Science Journals	Publication of peer reviewed research findings	Australian Government	Emphasis 2019-2020	• 31 Scientific papers / journal articles identified across all industries (148% of planned).
		National and international researchers	As specified in research partner communication & extension plan tables (Appendix C of CEP)	
		Program developers/ funders	As scheduled by RP (Appendix C of CEP)	
		Public/ private technology developers		

Appendix H. MPfN MEP Performance Indicators

Table H1 shows the MPfN Program M&E performance indicators as per the M&E Logical Framework (table 2.4 of the MEP).

Performance indicators have been evaluated based off a combination of document review and stakeholder engagement (quantitative and qualitative responses). The performance indicators have been evaluated based on a three-colour system with green reflecting strong performance, yellow showing moderate performance, and red showing weak performance.

Table H1. Evaluation of the delivery of activities and outputs against the MPfN MEP Performance indicators

Initiation Activities (Project Management & Planning): *Underpinning structures and process to guide and support activities and outputs — What will be managed and how?*			
Program Evaluation Level	**Research Project Detail**	**Performance indicator**	**Evaluation (colour) and Comment**
Delivered activities of B1 & Activity B2 of the Commonwealth Grant Agreement	Execution of research partner contracting.	Contracting process undertaken. Signing of the Program Management Agreement (PMA) by all parties and completion of individual contracts with satisfactory Full Research Proposals (FRPs).	• Contracting completed as required under DoV outputs 1(c). • Cotton and sugarcane stakeholders commented on delays and conflicting organisational timelines causing difficulty during sub-project contracting (5 comments).
	Engagement of Science Coordinator	Recruitment process undertaken to select a suitably qualified and experienced person.	• Contracting completed as required under DoV output 1 (a). • Stakeholders rated the Science Coordinator as highly effective (average rating 4.7, n=26)
	Establishment of Project Governance (PMC). Representatives from the research partners & sectors. Two meetings annually.	Representation and conduct of PMC: meetings held and topics and decisions made; reaction by participants to meetings and evidence of influence and actions taken by members as a result of participation.	• PMC established as required under DoV output 1 (c) • PMC members rated the PMC as highly effective (average rating 3.9, n=23)
	Adoption and execution of the MPfN Program Management Plan (PMP) by PMC.	Effectiveness of PMP as the primary tool for implementing the Program and execution of timely activities to deliver Outputs in accordance with the Commonwealth Grant Agreement.	• 131/132 (99%) of KPIs achieved or on track. 1/132 (1%) KPIs partially achieved.
		Effectiveness of PMP to monitor research partner progress and achieve KPIs within milestone dates.	

Delivered activities of B1 & Activity B2 of the Commonwealth Grant Agreement	Adoption and execution of the MPfN Communications & Extension Plan (CEP)	Effectiveness of CEP as the primary tool for executing Program communications and extension activities in accordance with conditions outlined in the Commonwealth Grant Agreement.	• Internal stakeholder rated the CEP, and support provided by the Science Coordinator, as highly effective in supporting the promotion of research activities & outcomes (average rating 4.2, n=30)
		Effectiveness of CEP in engaging key stakeholders in the Program's activities to increase adoption of NUE best practices.	• External stakeholders rated the extension and external communication activities as moderately effective at demonstrating industry opportunities for greater production and profit through increased NUE (average rating 3.6, n=19)
	Adoption and execution of the MPfN Monitoring and Evaluation Plan (MEP	Effectiveness of the MEP in assisting the Program to monitor research partner KPI and Output obligations.	• Stakeholders rated planning, monitoring, and reporting instruments as highly effective to support delivery of the MPfN objectives (average rating 4.2, n=34).
		Effectiveness of the MEP as a tool of the PMC in assessing progress towards final Program outcomes throughout project implementation.	
	Use and updating of an on-line M&E Data-base portal to engage with the project stakeholders and publish update and results from research work.	The details of the M&E Data-base (content, user-friendliness), access, downloads and other use statistics; feedback from users in usefulness and actions taken as a result of information gained.	• Stakeholders commented that the M&E database was a useful reporting tool for the program. • The Final Evaluation found the database fields did not directly align to planned outputs making assessment of plans difficult.
Program Materials (Products): *Research and stakeholder adoption — What will the project produce?*			
Program Evaluation Level	**Research Project Detail**	**Performance indicator**	**Evaluation (colour) and Comment**
Developed resources relating to the Outputs listed under Activity B4- B6 of Commonwealth Grant Agreement.	Fertiliser formulations/ smart blends identified and tested under a combination of commercial farm management practices & site conditions.	Effectiveness of specific fertiliser formulations/ smart blends in reducing losses and maintaining or increasing production under particular field conditions.	• 21/22 (95%) of KPIs relating to fertiliser formulations / smart blends (activity B4) achieved. 1/22 KPIs partially achieved.
	Fertiliser formulations/ smart blends identified and tested under a combination of farm management practices & site conditions.	Cost effectiveness of EEFs under a range of management scenarios determined and extent to which findings are extended to producer programs/groups through resource materials & activities.	• Producers and industry programs/service providers rated the MPfN research activities as moderate for their contribution towards changes in knowledge and resources relating EEF products & blends under a range of soil, climatic and system conditions (average rating 3.5, n=14)

Developed resources relating to the Outputs listed under Activity B4- B6 of Commonwealth Grant Agreement.	Decisions Support Tools to account for soil N mineralisation developed, trialled and extended.	Extent of change in confidence of advisors and producers to attend demonstration activities and likelihood of using developed NUE DSS when making N fertiliser decisions.	• Producers and industry programs/service providers rated MPfN research activities as strong for their contribution to new or improved resources relating to soil mineralisation and N budgeting (average rating 3.7, n=15)
	Industry Extension Materials prepared and extended through existing industry programs.	Extent to which advisors and producers attend input/ feedback activities and access resultant extension materials from websites.	• 3085 farmers and 2998 service providers attended extension activities.
	NUE benchmarks developed for horticulture (Mango & Cherry).	Evidence that benchmarks / guidelines have been determined and are underpinned by research findings	• NUE benchmarks and guidelines on track for development for both mango and cherries.
	NUE Best Practices determined and/ or validated, and integrated into existing industry programs.	Adoption of NUE recommendations by industry BMP Programs- Fert$mart (dairy), Six Easy Steps (6ES) (Sugar) and CottonInfo (Cotton) resources.	• New or updated industry resources delivered to date or ongoing for 8 research projects across all industries: – Included in 2021 Cotton Production Manual update. – Included in updated Dairy Fert$mart Nitrogen Guidelines and NUE Pocket Guide. – Made available to sugarcane Six Easy Steps N budgeting model and Smart Blending booklet ongoing. – Developed first Northern mango N BMPs. – Developed cherry N recommendations. • Overall, stakeholders rated the MPfN as moderate for contributing to new or updated industry resources.
	Reports prepared on research findings and extended to science audiences.	Number of peer reviewed research reports prepared as a result of the MPfN Program.	• Final and technical reports submitted and accepted to date: – Cotton (1713) – Dairy (1714) – Dairy (1715) – Dairy (1716) – Sugarcane (1717) – Sugarcane (1718) – All industries (1901) • Final and technical reports ongoing: – Cotton (1712) – Sugarcane (1719) – Cherry (1721) – Mango (1720)
	Journal articles on research findings prepared and peer reviewed.	Number of articles peer reviewed and published in science journals.	• 31 Scientific papers / journal articles identified across all industries (148% of planned).

Program Activities: *Research and stakeholder engagement outputs — What will the project deliver?*			
Program Evaluation Level	**Research Project Detail**	**Performance indicator**	**Evaluation (colour) and Comment**
Delivered research activities of the Outputs listed under Activity B4- B6 of Commonwealth Grant Agreement.	• Field based trials established and operating at the identified locations. Investigations being conducted to monitor/measure, interpret/ analyse, compare and evaluate against research hypothesis. • Laboratory based research established and operating to analyse field samples and validate field work. Water simulation, farm modelling and mathematical modelling research conducted to replicate field conditions/ management, determine effectiveness of potential practice options and inform decision support tools. • Industry Workshops/ field days conducted to seek input into research and to extend progressive research findings.	Extent to which the six research projects of Activity B4 deliver upon contracted Outputs: Sugar 4(a) to 4 (h), Horticulture 4 (i) to 4 (l) & Dairy 4 (m).	• 21/22 outputs achieved or on track for B4, 1/22 activities partially achieved.
		Extent to which the seven research projects of Activity B5 deliver upon contracted Outputs: Cotton 5(a) to 5 (b), Horticulture 5 (c) to 5 (f) & Dairy 5 (g) to 5 (k).	• All activity B5 outputs achieved or on track.
		Extent to which the seven research projects of Activity B6 deliver upon contracted Outputs: Cotton 6(a) to 6 (b), Horticulture 6 (c) to 6 (d), Sugar 6 (e) to 6 (h) & Dairy 6 (i) to 6 (m).	• All activity B6 outputs achieved or on track.
		Extent to which field trials provide a certain level of relevance to local producers and service providers resulting in ongoing engagement during project duration and generation of greater NUE understanding.	• Producers and industry programs / service providers rated demonstrations, farm visits, field days, and workshops as moderately effective to disseminate relevant information (average rating 3.6, n=17).
		Extent to which producers and service providers are increasing their knowledge on N dynamics under varying climatic/ management conditions and understand what this means to their farm business.	• Producers and industry programs / service providers rated the MPfN program as having moderately contributed to increased knowledge and understanding of the interplay of N dynamics under varying climatic/ conditions and what this means to a farm business (3.5, n=15)
	Collaboration taking place	Evidence that opportunities are provided for planned cross-sector collaboration on methodology approaches, shared information on progressive and final findings as well as key learnings. These opportunities are resulting in greater knowledge and understanding amongst the research partners/ collaborators.	• 75 collaboration activities registered in the MPfN database across all industries. • Stakeholders rated the MPfN's overall collaboration activities as highly effective (average rating 4.0, n=33). • 23 stakeholders (33%) commented positively on the MPfN collaboration activities in enhancing their research and extension

Delivered research activities of the Outputs listed under Activity B4- B6 of Commonwealth Grant Agreement.	Collaboration taking place	The details of partner forums (location, topics, process), extent of representation of targeted stakeholders, stakeholder reactions, input received and actions taken as a result.	• Partner Forums held in 2017, 2018, 2019, and 2020 (online due to COVID disruption), and 1 partner forum planned after this report (2021). • Stakeholders rated the annual partner forums highly as an internal communication method that supported internal collaboration (average rating 4.5, n=28).
		Documented outcomes of both formal and informal collaborations taken place between research partners, project collaborators and further external stakeholders as a result of MPfN Program activities.	• Stakeholders rated the MPfN's overall collaboration activities as highly effective (average rating 4.0, n=33). • 23 stakeholders (33%) commented positively on the MPfN collaboration activities in enhancing their research and extension.
	Mid-term evaluation report	Evidence that the MPfN Program is progressing towards greater knowledge and understanding in relation to the three Intermediate Outcomes: • What knowledge and understanding gains have been made at this point? • What have been the enabling activities to stimulate greater knowledge and understanding? • Are there signs that greater knowledge and understanding will lead to adoption of future recommendations? • What are the current indications that there are profitability and production gains to be made from increased NUE?	• Delivered as planned.
	Deliver Outputs of Activity B3: Program Communications conducted in accordance with the MPfN Communications and Extension Plan (CEP).	Extent to which the Science Coordinator/ Program Manager meet requirements of Outputs 3 (a) to 3 (c).	• All activity B3 outputs achieved or on track (Appendix F).
		Extent to which the Science Coordinator appropriately organises research/ sector partner communication activities and delivers upon the requirements of the actions and schedule of Section 9 "Program Implementation Plan" of the CEP.	• Delivery of 20/24 tools (83%) of the CEP *Program implementation Plan* assessed as strong (Appendix G) • Internal stakeholder rated the CEP, and support provided by the Science Coordinator, as highly effective in supporting the promotion of research activities & outcomes (average rating 4.2, n=30)
		Extent to which planned communications have been undertaken; extent of reach to targeted stakeholders; level of awareness and interest in contents; actions taken as a result of communication activities including access and use of resource and engagement in project activities.	• Stakeholders rated the MPfN extension and communication activities as moderately effective at demonstrating industry opportunities for greater production, profit, or improved environmental outcomes through increased NUE (average rating 3.6, n=61).

Intermediate outcomes: Achievable within the life of the project—What will result from the project activities?			
Program Evaluation Level	**Research Project Detail**	**Performance indicator**	**Evaluation (colour) and Comment**
Activity B4- A greater knowledge and understanding of how enhanced efficiency fertiliser (EEF) formulations can better match a crop or pasture's specific N requirements.	Question: What are the most suitable fertiliser product types or blends for a producer's individual circumstances?	Extent to which there is greater knowledge/ understanding of EEF products/ blends which result in increased NUE under a range of soil, climatic and system conditions across the four sectors.	• Stakeholders rated the MPfN highly for contributing to knowledge and understanding of EEF products/ blends (average rating 3.9, n=51). • Stakeholders rated the MPfN moderately for contributing to new or improved resources (such as strategies, tools, and technologies) relating to EEF products/ blends (average rating 3.5, n=46).
	Question: What is the cost effectiveness of Enhanced Efficiency Fertilisers, under a range of soil and climatic conditions, and product blends?	Extent to which knowledge/ understanding of the profitability and production benefits of EEF product/ blend use has been determined and extended across the four sectors.	
		Extent to which research has demonstrated increased knowledge/ understanding of how EEF use can reduce N loss from the farm system without impact to product yield or quality.	
	Question: Can better EEFs be developed that release nitrogen based on the demands of the crop?	Extent to which the potential for new EEF formulations and combinations of existing EEFs to better match nitrogen crop demand has been determined.	
	Question: Can polymer and / or sorber technology be used to improve the ability of vegetative buffer strips to remove nutrients and sediment from farm water run-off?	Extent to which the research demonstrates future potential for new EEF technology to reduce N loss from the farm system through simulation and modelling techniques.	
Activity B5- A greater knowledge and understanding of the interplay of factors to optimise nitrogen (N) formulation, rate and timing across industries, farming regions and irrigated/ non-irrigated situations.	Question: How can N be managed most effectively to make the most of available water and soil-N, to maximise productivity and quality, minimise losses to the environment and provide economic benefits to the producer?	Extent to which knowledge/ understanding of total losses of N from certain farming systems has increased.	• Stakeholders rated the MPfN highly for contributing to increased knowledge and understanding relating to the interplay of factors to optimise NUE in irrigated systems (average rating 4.0, n=54).

Activity B5- A greater knowledge and understanding of the interplay of factors to optimise nitrogen (N) formulation, rate and timing across industries, farming regions and irrigated/ non-irrigated situations	Question: How can nitrogen and irrigation management be modified to minimise nitrogen losses and maintain or improve productivity?	Extent to which significant N loss pathways are understood and have resulted in targeted recommendations for improved management of NUE on irrigated farms.	• Stakeholders rated the MPfN highly for generating new or improved resources for understanding and managing the interplay of factors to optimise NUE in irrigated systems (average rating 3.7, n=50).
		Extent to which profitability and production outcome knowledge/ understanding has increased on adopting identified practice modifications in N and irrigation management across the four sectors.	• Stakeholders who have adopted or observed adoption of recommendations in irrigation systems had a high level of confidence that the MPfN NUE strategies will result in more consistent profitability and reduced negative environmental impact (average rating 4.2, n=10).
	Question: How effective are current BMPs for nitrogen management in improving nitrogen use efficiency, productivity, profitability and environmental impact on farm?	Extent to which research has resulted in changed BMP recommendations or the preparation of new guidelines/ benchmarks for industry.	• New or updated industry resources delivered to date or ongoing across all industries. • Overall, stakeholders rated the MPfN as moderate for contributing to new or updated industry resources (average rating 3.6, n=60).
		Extent to which likely impacts upon profitability, production and the environment are understood and have been demonstrated to industry through research outputs.	• Stakeholders rated the MPfN extension and communication activities as moderately effective at demonstrating industry opportunities for greater production, profit, or improved environmental outcomes through increased NUE (average rating 3.6, n=61).
Activity B6- A greater knowledge and understanding of the contribution (quantifying rate and timing) of mineralisation to a crop or pasture's nitrogen budget	Questions: Can MIR/NIR be used to predict soil mineralisable N and how effective is it compared to current 'soil C' based methods for estimating N mineralisation index for soils?	Extent to which the effectiveness of MIR/NIR has been explored against other methods to predict soil mineralisable N.	• NSWDPI (sugar) reported that standard methodology of measuring potentially mineralizable N (PMN) across 7-300 days were correlated to laboratory MIR. MIR calibrations showed promise in the measurement of both short and long-term soil mineralisable N stocks. The cheap and rapid NIR test was under discussion with a commercial analytical provider as at Feb 2021, and further negotiation with the sugar industry and the 6ES will occur. • No other sub-projects reported researching the potential for MIR/NIR as a predictor of soil mineralisable N.
	Question: What tools can producers use to access better information regarding N dynamics and seasonal availability to inform their decisions for a better economic outcome?	Extent to which developed tools/ resources provide increased knowledge/ understanding for producers (and services providers) to make more informed decisions in source, rate, timing and placement of N fertiliser.	• Producers and service providers rated the MPfN highly for contributing to increased knowledge and new or improved resources relating to N mineralisation (average rating 3.7, n=17).

ENDS