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Monitoring Evaluation Reporting and Improvement (MERI) Plan
MLA Phosphorus Use Efficiency Program 2011-2016

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1. Introduction

Monitoring, Evaluation, Reporting and Improvement (MERI) is an approach that is iterative and integrative and aims to result in accountability, learning and adaptive management.

The structure of this MERI Plan is informed by the four strategic investment themes of the Phosphorus Use Efficiency Program. While some integration across themes is anticipated, the four themes are the building blocks of the Program.

This plan details a comprehensive monitoring and evaluation framework.

1.1 Purpose

The purpose of the plan is to:

- demonstrate how the Program, through a number of research and development projects, will monitor and evaluate the extent to which it is achieving its objectives and the extent to which it is contributing to the expected outcomes;
- provide evaluation questions and indicators to assess progress towards the Program's outcomes and objectives;
- assist program managers, project leaders and implementers to address specific evaluation questions, evaluate and report on progress towards and achievement of specified outcomes by planning, budgeting for and implementing good MERI.

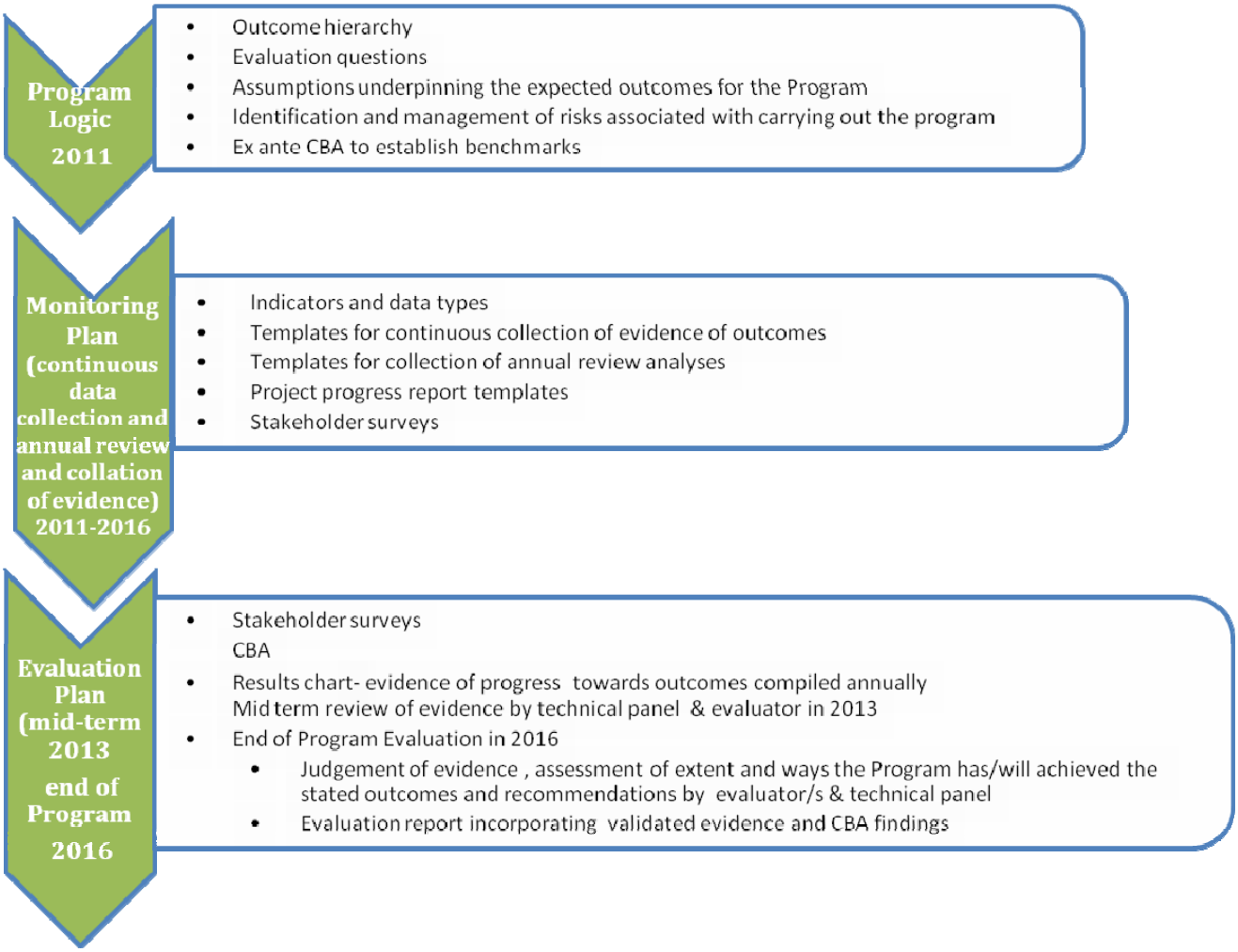
1.2 The plan at a glance

MERI planning comprises a three-phase cycle including preparation, implementation and review. The three phases will be completed as follows:

- Preparation — before project implementation
- Implementation — annual reflection on progress.
- Review and assessment — mid way through and at the end of the Program.

The chart below illustrates the components of the MERI Plan and the process for designing and implementing the plan.

Phosphorus Use Efficiency Program MERI Plan at a glance



1.3 Impact evaluation questions

A series of evaluation questions, directly relating to achievement of the outcomes or impact, provide the overarching framework for evaluation of the Program. The impact evaluation questions for the Program are:

Impact evaluation questions for the Program
To what extent and in what ways can/will/has the *Phosphorus Use Efficiency Program* **increased profitability & sustainability of pasture production?** 1. To what extent and in what ways has the Program built innovation capacity in the private sector through the development of partnerships and by providing information/ training that (can be, will be, has been) contributed to more appropriate* and profitable P use? (Theme 1) 2. To what extent and in what ways has the Program provided producers with information that has assisted them to make P product choices based on evidence? (Theme 1) 3. To what extent and in what ways has the Program demonstrated proof of concept for developing more P-efficient plants? (Theme 2) 4. To what extent have new technologies been identified, through the program, to reduce non-productive losses in P-fertiliser use? (Theme 3) 5. To what extent and in what ways has the Program provided knowledge to inform future global P-supply strategies? (Theme 4) 6. To what extent has the Program produced knowledge and/tools that (can be, will be, has been) used by advisors, the fertiliser industry and governments to assist in promoting more appropriate* and greater efficiency of phosphorus use? (All themes) *Appropriate = not excessive i.e. not beyond critical P in particular situations but a level of P that sustains stocking rates and production targets while minimizing off-farm environmental impacts.

Monitoring data will provide a key source of information for evaluation. Monitoring will be ongoing throughout the program assisted by regular collection and documentation of data/information to indicate the extent to which the themes and overall Program are making progress towards expected outcomes.

2. Scope

2.1 Program Timeframe 2011 - 2016

Program Budget **$10 M**

2.2 Program objectives

The *Program* will enhance productivity, profitability and sustainability in the grazing sector through better evidence-based management of pastures through greater efficiency in the use of *Phosphorus*. This will be achieved through investment in RDE activities that:

- build innovation capacity and confidence of those involved in the fertiliser supply chain and meat and livestock industries to use P more efficiently for sustainable pasture productivity and enterprise targeted profitability;
- Foster a culture of nutrient best practice management to minimise environmental degradation, nutrient pollution and carbon footprint that can arise from poor nutrient use efficiency;
- develop and implement novel low-P grazing systems that will reduce fertiliser inputs;
- identify existing and/or novel plants with traits that also enable solubilisation or extraction of P already accumulated in sparingly-available soil pools;
- develop technology or management options to control release of phosphate to soil and address the seasonal mismatch between availability of P in soil and pasture requirements for growth;
- examine fertiliser placement options to increase P availability for plants;
- evaluate the variation in key root traits of the keystone pasture legumes to select P-efficient cultivars;
- address the widespread problem of root damage on pasture legumes which may negate attempts to improve P-use efficiency and the value of improved legumes;
- position the industry to take advantage of nutrient efficiencies currently being developed in crop species using conventional and GM technology.

MLA has identified four themes under which the objectives outlined above will be met. These themes were informed by a scoping study and expert workshops. There are 3 technical themes and an overarching theme:

1. P-efficient farming
2. Low-P farming systems
3. Fertiliser technology.
4. P supply options for Australia

2.3 Program Rationale

Phosphorus (P) is an essential input for farms on low P soils and constitutes a significant input cost for most farming systems in southern Australia. Rising P-costs present substantial potential threats to management of southern Australian grazing systems through the impact on profitability and business.

Even in low-input agriculture it is essential to at least replace P removals to protect the sustainability of production. However, for most commercial farms, it is also essential for high production per hectare which allows a business to minimise overhead costs per DSE and to maximise profitability and return on investment. Presently, P-fertiliser inputs account for about 10% of all expenses (including wages) and amounts to about 21-26% of enterprise costs on "average" grazing farms (southern Australia).

Although the cost of P-fertiliser has been very volatile in recent years it has remained a profitable investment for a grazing business. However, increases in fertiliser cost directly reduce profitability and significantly increase the business risk associated with fertiliser investments. This can substantially reduce the attractiveness of applying fertiliser.

It has been forecast that peak P could occur within 25-30 years. This is the point at which global supply will not keep up with demand for P and the cost of P will escalate dramatically. This grim analysis prompted the International Fertiliser Development Center to re-assess global "reserves" and "resources" and they have claimed recently (September 2010) that the risk of peak P in this timeframe is remote. The debate about the sustainability of P-resources is, however, unlikely to dissipate because global food security is dependent on fertiliser use, high-quality rock P reserves are a finite resource, and the data underpinning estimates of the longevity of the reserves are of variable reliability. What is certain is that the price if P-fertiliser has doubled in the last 10 years and that as the world moves to mine new P-reserves, which are of lower quality or harder to extract, the cost of P fertiliser will continue to increase.

Presently Australia sources about half of its annual P requirements domestically and half from overseas. The majority is used in agriculture with a P-balance efficiency of only 25% (i.e. 4 units of P are applied as fertiliser to produce only 1 unit of P in products). About 90% of the P in agricultural products is exported, the rest is consumed domestically. In some countries, global P-shortages would result in increased emphasis on recovery and recycling of P from waste streams. For some countries, this will go close to covering P needs. However, in Australia recycling will cover only 5-10% of the annual P requirements of agriculture. While there is no doubt that there will be an increasing role for P-fertilisers derived from waste streams, the major avenue for addressing increases in P-fertiliser costs in Australia will be through improved P-use efficiency in agriculture. Significant opportunities exist to lift the profitability and sustainability of agricultural production and to improve the environmental credentials of farming, if the efficiency with which P is used in agriculture can be improved.

The large inefficiency associated with P use in agriculture and the grazing industries in particular, also represents a substantial opportunity to reduce costs by promoting a targeted approach to soil fertility management and by researching and developing P-efficient farming systems, plants and fertiliser technologies (Adapted from (Simpson, R., Richardson, A., and McLaughlin, M. *Review of phosphorus availability and utilisation in pastures for increased pasture productivity*, CSIRO for MLA, June 2010).

3. Program Logic

3.1 Outcomes hierarchy for the Program

Program logic is the rationale behind a program—what are understood to be the cause-and-effect relationships between program activities, outputs, intermediate outcomes, and longer-term desired outcomes. Program logic shows a series of expected consequences, not just a sequence of events. It thus facilitates planning, execution and evaluation of an intervention (DEWHA, 2008); OECD 2002).

Program logic in this context consists of an outcomes hierarchy, the assumptions that the hierarchy is based on and an analysis of the risks in the implementation arrangements for the Program by looking at how reliable and how important each of the assumptions is.

Program logic provides a good basis for reflecting on progress, determining which strategies are working (and which are not) so strategies can be continually adapted to enhance progress in the desired direction.

The outcomes hierarchy for the Program illustrates the expected outcomes that will result at different stages from implementing the projects and shows the assumed series of causes and effects over time as the projects are implemented.

An outcome is the result achieved at the defined levels of the outcomes hierarchy in the program logic.

The timeframe applied in the program logic for the Program uses:

- the long term vision (10+ years)
- longer-term outcomes - - (5 yrs- end of Program)
- intermediate outcomes (2-3 years)
- immediate outcomes (1-2 years)
- foundational activities (year 1).

The outcomes hierarchy for the Program is at **Attachment 1.**

3.2 Expected products for identified target audiences

Table 1 shows the products that are expected to be developed through each of the four program themes and indicates the anticipated end-users or beneficiaries of those products.

Table 1 Expected products for identified target audiences

Outcome Level	*Products and target audiences*							
Vision **10 years**	***Theme 1***		***Theme 2***		***Theme 3***		***Theme 4***	
	Increased profitability & sustainability of pasture production as a result of efficient and sustainable phosphorus use							
Program Goals **5 years**	Centralised database of industry practices for P management	Researchers Advisors Fertiliser industry	Technology package and logo with management guidelines for critical P pasture/soil systems Training & information modules P-efficient germplasm Report on feasibility of root disease resistant plants Germplasm material for identification of DNA markers that could be developed and used further in a commercial breeding program	Seed companies Agricultural re-sellers Advisors Plant breeding companies Seed companies Ag. re-sellers Advisors MLA Plant breeding companies				
Intermediate outcomes **2-3 Years**	Information to build industry confidence to operate at optimal P inputs for targeted level of business profitability Database house secure project outputs Standard protocols/ measures Report on industry soil fertility	Advisors Producers	Report on the fate of applied P as organic or inorganic fertiliser	Researchers Advisors Fertiliser industry	P-efficient granular products PCT patents Report on environmental nutrient flows	Fertiliser industry MLA Researchers Advisors		
Immediate outputs/ results **1-2 years**	Report on environmental impacts of P losses Brochure on myths and truths about phosphorus and opportunities for increased P-efficiency and productivity More reliable/accurate soil testing methodology	Producers Fertiliser Industry Researchers	Meetings/field days to impart new knowledge	Researchers Extension officers Advisors	Report on specifications for P-release characteristics modelled for WA, coastal NSW and south east SA	Researchers Advisors Fertiliser industry	Literature review on global P availability, threats and opportunities for Australia	MLA Researchers Councils Policy

3.3 Assumptions

Program logic includes assumptions upon which the outcomes hierarchy is based i.e. how change is expected to occur. Importantly, the program logic is a *model*—not reality. It depicts assumed causal connections, not true cause-and-effect relationships. Identifying the underlying assumptions provides a focus for testing and adapting the logic. The assumptions that underpin the expected outcomes in the outcomes hierarchy are set out in Table 2.

Table 2: Assumptions underpinning the program logic/theory of change

Outcome Level	***Assumptions***			
Theme	***Theme 1***	***Theme 2***	***Theme3***	***Theme4***
Vision 10 years		Technology exists for stable gene transfer into an elite line	Industry adopts new technology	
		P-benefits outweigh other impediments (e.g. root diseases)	New technology is effective and efficient given the price of P	
		Trait interactions are understood		
		Useful variation has been identified	There are no undesirable outcomes	
		New legumes provide sufficient production benefits for farmers to adopt		
Program Goals 5 years			Knowledge of quantification, is available	
			Knowledge of timing of nutrient losses	
		Genes can be identified and mechanisms can be transferred and be effective in a model plant across a range of soil systems		
	Adoption on farms at a sufficient scale		Knowledge of last uptake for multiple systems is available	
		Low-P alternatives exist with applicability across large areas		
		Sufficient usable genetic variation exists for P-efficiency for productivity gain		
	Sustainable levels of P-use can be determined	Access to diverse germplasm for P-efficiency	Climate behaves as expected in modelling	
Intermediate	Producers will adopt best practice soil testing methods	Genes exist and can be expressed in heterologous		

Outcome Level	*Assumptions*			
Theme	*Theme 1*	*Theme 2*	*Theme3*	*Theme4*
outcomes		system	Appropriate co-operators and land available	
2-3 Years	Industry will adopt recommended best practice Industry confidence in new practices can be built 'Best practice' can be defined	P-efficient legumes exist Lab. And glasshouse tests reflect field performance	Resources are available	
Immediate outputs/ results **1-2 years**	Sites available to conduct tests associated with EIA Findings about credibility of alternative products and management approaches will debunk myths about P impacts Fertiliser re-sellers will participate in training Soil tests are accurate (Only ASPAC data used) Producers will participate in training & soil testing Current owners of data are prepared to be involved in soil analysis Correct sampling system applied to different grazing systems		Physical and financial resources are available Modelling results indicate significant gains in P-efficiency	Findings will be credible enough to be adopted by councils, policy-makers to underpin a P-futures strategy for Australia
Foundational Activities **Year 1**	Some baseline nutrient management data is available, accurate and acceptable. Fertiliser supply chain and producer/advisor networks will engage and cooperate	Expertise in accurate field evaluation Existing expertise in breeding and screening Germplasm of keystone species exists Expertise and facilities available	Models can be paramatized Modelling skills are available Modelling framework is available Physical and financial resources are available	Adequate reliable information exists about environmental impacts and life-cycle qualities of P and this information is accessible

3.4 Managing risks

Understanding the external and internal environments/ systems the program will operate within is critical when it comes to assessing the relevance of strategies and activities. Knowing the operating environment also helps to anticipate operational problems and judge the Program's contribution to improving PUE as it relates to pasture production, sustainability and profitability.

Project leaders' control over factors in the project environment that influence the achievement of outcomes decreases at the later stages of the program when many factors beyond the direct control of project managers will influence the impact of activities. At the start of the program managers and staff have a higher level of control over outcomes. External factors are generally unlikely to pose serious threats to carrying out activities at the beginning. The Program's accountability at the higher levels of the outcomes hierarchy decreases but never disappears entirely.

High level risks

High level risks are those where there is a high likelihood that the assumption in the program logic is wrong and if, so the consequences are likely to seriously impact on achieving outcomes. The risk assessment for the Program is summarised in Table 3. The summary illustrates that some high level risks were identified.

High risk aspects of the Program are apparent because of the exploratory nature of the research being undertaken, particularly in themes 2 and 3. The potential costs of not acting to discover ways to increase P-efficiency whereby phosphorus could be unavailable or unaffordable in future, arguably justify investment in a forward-looking research program to increase P-efficiency.

High level risks were identified in Themes 2 and 3 where the aim is to develop P-efficient plants and technologies. Risks are mostly associated with uncertainty regarding whether trait interactions can be determined and whether new plant species will be P-efficient, affordable and will lead to increased pasture production. Scientists will draw on current knowledge in the field and will adopt an adaptive research approach in order to manage these risks.

In addition, due to climatic uncertainty, it is difficult to be certain at the outset of theme 3 whether laboratory and field data will be able to be accurately compared. This risk can only be managed through effective planning and adaptive responses by project leaders. Awareness that the risk exists will enable the project managers to review and manage this risk throughout the project.

Moderate level risks

A number of moderate level risks were identified throughout the four research themes of the Program. In general, they relate to adoption of recommended PUE practices by producers and advisors and of new cultivars/technology by the fertiliser industry. These risks are typical in R&D programs.

There appear to be reasonable strategies in place to manage the moderate-level risks throughout the program. The internal and external communication and adoption strategy will be an important element in engaging stakeholders and promoting project findings and necessary partnerships to advance new PUE products. Strategies to manage the risks were identified and will be implemented early in the projects to avoid time delays and impact on achievement of outcomes. The risks and associated strategies to manage them will be regularly reviewed with a view to project plan/contract variation if necessary to avoid inefficient investment.

Table 3: Risks and risk management

Outcome Level	*Assumptions*	*Risk*	*Risk level*	*Risk management strategy*
Vision 10 years +	Useful variation has been identified (theme 2)	Traits have low heritability	High	Use prior knowledge to avoid trait interaction pitfalls Change breeding emphasis to other root limiting factors
	Trait interactions are understood (theme 2)		moderate	
	P-benefits outweigh other impediments (e.g. root diseases) (theme 2)	Seed supplies inadequate for requirements Slow pasture renovation rates	high	Effective extension program that emphasises P-saving opportunities
	New legumes provide sufficient production benefits for farmers to adopt (theme 2)	Species have low areas of use	high	Shift emphasis to other technologies
	Trait interactions understood (theme 2)	Graziers not interested in sewing	moderate	Use existing knowledge to avoid pitfalls
	Technology exists for stable gene transfer into an elite line (theme 2)	Technology not accepted for commercial release or adopted by industry	low	Demonstrate safety and value to industry Effective education and communication approaches
	Industry adopts new technology (theme 3)	P prices fall dramatically	low	Early involvement of industry in research
	New technology is effective and efficient given the price of P (theme 3)	Technology fails in the market place	high	Proper field validation
	There are no undesirable outcomes (theme 3)	Cost benefit analysis by industry jeopardises commercialisation (no value proposition)	low	
Program Goals 5 years	Sustainable levels of P-use can be determined (theme 1)	Required scale not achieved	high	National scale both public and private
	Access to diverse germplasm for P-efficiency (theme 2) Genes can be identified and mechanisms can be transferred and be effective in a model plant across a range of soil systems (theme 2)	Traits have minor impact on P-efficiency Species have low areas of use	low	Engage germplasma owners
	Sufficient usable genetic variation exists for P-efficiency for productivity gain (theme 2)		high	Shift emphasis to evaluation of alternative species or use of GM
	Low-P alternatives exist with applicability across large areas (theme 2)	Technology failure due to complex G x E x M interaction	low	Shift emphasis to evaluation of GM solutions or keystone species
	Genes can be identified and mechanisms can be transferred and be effective in a model plant across a range of soil systems (theme 2)		high	Progress with traits that are robust across multiple environments if benefit opportunities are apparent
	Knowledge of quantification, is available (theme 3)	Climate change Cultivar change alters nutrient demand curve Episodic events (risk of designing for a range of	high	Develop goog models of plant demand leakage and fixation trends

Outcome Level	Assumptions	Risk	Risk level	Risk management strategy
		conditions)		
	Knowledge of timing of nutrient losses Theme 3)			
	Knowledge of last uptake for multiple systems is available (theme3)	Producers do not trust the rationale for adopting recommended new soil testing practices	low	Clarify issues currently causing confusion due to producers receiving mixed messages
	Producers will adopt best practice soil testing methods (theme 1)			
Intermediate outcomes ***2-3 Years***	Correct sampling system applied (theme 1)	Unable to link cropping and pasture monitoring systems	low	Collaborate with GRDC
	Industry will adopt recommended best practice (theme 1)	Industry will not adopt recommended practices	moderate	Training programs and evidence-based Guidelines
	Industry confidence in new practices can be built (theme 1)	Industry will not adopt without strong evidence	moderate	Clarify issues currently causing confusion due to producers receiving mixed messages
	Best practice' can be defined (theme 1)			
	Lab. And glasshouse tests reflect field performance (theme 2)	Screen for wrong traits (inadequate knowledge)	moderate	Modify screening process as required and validate lab tests in the field as early as possible
	P-efficient legumes exist (theme 2)	False indication of P-efficiency or P differences too small to be of value	moderate	Modify testing procedure and validate lab tests in the field as early as possible
		Species has low area of use		Shift emphasis to evaluation of GM solutions or keystone species
	Genes exist and can be identified in heterologous system (theme 2)	Abuse of correct genes	low	Avoid limiting to a single trait and/or gene for a trait
	Climate behaves as expected in modelling (Theme 3)	Glasshouse results not relevant for field conditions	high	Do more relevant glasshouse experiments
		Fieldwork risks including disease, pests, climate etc		Experienced field collaborators and project staff
	Appropriate cooperation from stakeholders and land available (theme 3)			
	Resources are available (theme 3)	Program content and delivery model doesn't drive adoption	low	Pilot projects
	A case exists that will ensure producer involvement			
Immediate Outcomes ***1-2 years***	Current owners of data are prepared to be involved	Data from incompatible sources (lab and field)	low	ASPAC data
	Sites are available to provide data for the EIA (theme 1)	Competition from other projects for researchers		Work with other projects and industries e.g. dairy
	Modelling results indicate significant gains in P-efficiency (theme 3)	Competition from other projects for researchers	moderate	Work with other projects and industries e.g. dairy
		Model predictions are wrong leading to mis-evaluation of potential of the technology		Validate modelling through peer review
	Modelling results indicate significant gains in P-efficiency (theme 3)			

Outcome Level	*Assumptions*	*Risk*	*Risk level*	*Risk management strategy*
	Findings will debunk myths about P impacts (theme 4)	Findings validate myths	moderate	Carefully define terms of literature search Targeted research questions
	Findings will be credible enough to be adopted by councils, policy-makers to underpin a P-futures strategy for Australia (theme 4)	Poorly validated literature review strategy		Rigorous international literature search strategy Effective analysis of the strategy
	Some baseline nutrient management data is available, accurate and acceptable (theme 1)	Current data repositories inadequate with data fields unaligned	low	Effective analysis of the existing data
Foundational Activities	Expertise in accurate field evaluation (theme 2)	Access denied Inappropriately trained staff draw wrong conclusions	Low	Engage experienced researchers
	Existing expertise in breeding and screening (theme 2)	Inadequate funding to attract experts	low	Sufficient funding and collaborations
	Germplasm of keystone species exists (theme 2)	Access denied	low	Engage germplasm owners
	Expertise and facilities available (theme 2)	Funders see no benefit in GM technology	low	Demonstrate the potential benefit of GM over existing options
	Models can be paramatized (theme 3)	Model predictions are wrong leading to mis-evaluation of potential of the technology	moderate	Validate modelling through peer review
	Modelling skills are available (theme 3)			
	Modelling framework is available (theme 3)	Disease	low	Standard research risk management
	Physical conditions are favourable (theme 3)	Power outages		
	Adequate reliable information exists about environmental impacts and life-cycle qualities of P and this information is accessible (theme 4)	Information is inadequate for valid analysis	moderate	Rigorous literature review strategy

4. Monitoring

Monitoring is the regular collection and analysis of information to assist timely decision making, ensure accountability and provide the basis for evaluation and learning. Monitoring the progress of the Phosphorus Efficiency Use Program will involve continuous and methodical collection of data to provide managers and the main stakeholders of the Program with early indications of progress and achievement of objectives (IFAD nd).

The program logic provides the base upon which to develop a plan to monitor progress, evaluate the Program and identify ways to learn and increase the chances of achieving the expected outcomes by adapting management of the Program and/or the projects along the way. Regular monitoring will provide the basis for evaluating:

- impact through the selected investment strategies
- the appropriateness of activities and processes
- the efficiency of management and processes in running activities/ systems

A combination of quantitative and qualitative monitoring data forms a rigorous base of evidence from which to assess progress, outcomes and what's working and what's not.

Table 4 sets out a plan for monitoring progress towards the Program outcomes. The plan is organised according to the themes that provide the investment structure of the Program.

The monitoring plan consists of:

- **Evaluation questions for the Program** - These questions are based on the objectives of the Program.
- **Monitoring question**s – A set of sub-evaluation questions to be addressed in each theme in order to address the evaluation question.
- **Indicators** – the units of information to be measured over time to help show changes in a specific condition. A given goal or objective can have multiple indicators.
- **Information/data required -** data required to answer the monitoring questions.
- **Data Source –** Where the data or information will come from.
- **Frequency** – How often the data will be collected and who will collect it.

Much of the monitoring will be carried out internally. Regular internal data collection and analysis has the benefits of both keeping abreast of how the Program and its various components are performing and being able to apply an adaptive management approach. In this way both impact and efficiency can be maximised throughout the life of the Program.

Continuous monitoring data will be collated to provide evidence for mid-term and end of Program evaluations. The mid-term and end of Program evaluations will address the overall evaluation question for the Program:

> ***To what extent and in what ways can/will/has the Phosphorus Use Efficiency Program increased profitability & sustainability of pasture production?***

The monitoring plan requires 3 monitoring approaches:

1. Program Coordinator and Theme co-ordinator to collate information annually from:
    - Program-level management records/reports
    - Project progress reports
    - MLA grower survey
2. Independent surveys of researchers, advisors and investment partners at mid-term and at end of Program
3. Documented records and collated information compiled at annual SBI reviews by SBI members.

Baselines developed through the ex-ante CBA may assist in establishing additional indicators related to adoption, costs and savings.

Overall evaluation question for the Program:

To what extent and in what ways can/will/has the Phosphorus Use Efficiency Program increased profitability & sustainability of pasture production?

Table 4 Monitoring Plan

Evaluation question	Monitoring questions	Indicators *Data required to address the question*	Data Source	*Frequency*
		THEME 1		
To what extent and in what ways has theme 1 built innovation capacity among producers and in the private sector through the development of partnerships and by providing information/ training that (can be, will be, has been) contributed to more appropriate* and profitable P use?	To what extent has information/training been provided to producers and advisors?	No. of training events held and target audience No. newsletters/brochures etc on appropriate P use and target audience No. producers attending events No. advisors attending events	Project records	Annual by project team in years 1 & 2
		No. producers/advisors satisfied with information/ training	Standard event evaluation form by participants	At each event by project team in years 1 & 2
		No. producers who have changed management practice	Analysis of P soil	Annual by project team in years 1 & 2
		Types of changes producers have made in fertiliser use and outcomes of those changes		
	To what extent has information/training contributed to changed understanding of PUE and associated management practices?	No. producers operating at or below critical P value or target Colwell P for management system	Existing farm survey data Producer survey at training events Follow up phone survey	Data analysis by project team At events by project team Bi-annual phone survey in years 1 & 2
		No. producers using '5 Steps' method/ or new agreed industry P calculator tool and their level of confidence in it		
		No. participating producers who have not changed management practice and why		
		No. advisors using '5 step'/ or new industry P calculator tool	Advisor survey at training events Follow up phone survey	At events by project team Bi-annual phone survey in years 1 & 2
		No. participating advisors not using '5 step'/ or new industry P calculator tool and why		
To what extent and in what ways has theme 1 provided producers with information that has assisted them to	To what extent is there increased producer/advisor confidence in selection of appropriate P fertilizer product for	No. producers/advisors who understand criteria for selecting appropriate P fertilizer product for their specific farming system	Standard event evaluation form by participants	At events by project team in years 1 & 2
		Type of evidence influencing producer understanding and choice of fertiliser	Existing farm survey data Producer survey at training events	At events by project team Bi-annual phone survey in years 1 & 2
		No. producers who understand soluble P concentration in the products they use		

Evaluation question	Monitoring questions	Indicators *Data required to address the question*	Data Source	*Frequency*
make P product choices based on evidence?	farming system?	$ cost in each unit of P	Follow up phone survey	
	To what extent does the industry have a greater understanding of soil fertilizer culture and status?	No. producers soil testing regularly No. producers who understand the concept of critical P, PBI and targeted Colwell P for strategic approach to enterprise operation No. producers using P calculator tools to operate systems at P maintenance or P building phase Unexpected outcomes		
THEME 2				
To what extent and in what ways has theme 2 demonstrated proof of concept for developing more P-efficient plants?	To what extent is increased understanding of the critical P values of keystone legumes?	Critical P requirement for individual species/cultivars for range of PBI soils Findings and cultivar lists published in peer reviewed journals (year 4)	Experimental/fieldwork data	year 3
	To what extent is increased understanding of keystone alternatives?			
	To what extent is increased understanding of novel P-efficient plants?	Novel P-efficiency traits expressed in plants	Experimental/fieldwork data	year 3
	Has the feasibility of breeding keystone species been determined?	Variation exists in P-efficient root traits Findings published in peer reviewed journals (year 4)		
To what extent has theme 2 produced knowledge and/tools that (can be, will be, has been) used to	To what extent is there increased understanding of the interaction of root disease and response to P application?	Extent of change in the critical P requirement due to root disease Findings published in peer reviewed journals (year 4)	Experimental data	Years 2,3, 4 and 5

Evaluation question	Monitoring questions	Indicators *Data required to address the question*	Data Source	*Frequency*
assist in promoting more appropriate* and greater efficiency of phosphorus use?	To what extent is there increased understanding of GM and non-GM mechanisms that increase P-efficiency?	P-efficiency traits expressed Understanding of the GxExM impact on trait expression Findings published in peer reviewed journals (year 4)		Years 3, 4 and 5
	To what extent have strategic partnerships been established?	Technology package/management guidelines marketed to seed companies and Ag-re-sellers for current keystone and alternative pasture legumes	Project records	Year s4 and 5
		Seed companies and Ag-re-sellers agree to commercialise the technology package current keystone and alternative pasture legumes		
	To what extent is new knowledge produced through theme 2 being used by producers and advisors?	Published and distributed new benchmarks and management guidelines with tool and training package revised and updated as informed by scientific evidence for current keystone species and alternative pasture legumes	Project records	
		No. producers using the management guidelines for critical P pasture/soil systems	Producer survey at training events Follow up phone survey	Years 4 and 5
		No. advisors using the management guidelines for critical P pasture/soil systems	Advisor survey at training events Follow up phone survey	
	To what extent was germplasm identified with potential for further development?	Data demonstrating proof-of-concept for P-efficient root traits. Germplasm available for development of DNA markers for use in commercial breeding program	Experimental data	5 years
Theme 3				
To what extent has Theme 3 produced knowledge and/tools that (can be, will be, has been) used to assist in promoting more appropriate* and greater efficiency of phosphorus use?	To what extent has Theme 3 produced new products and opportunities for commercialization?	New P fertiliser products that increase P efficiency by reducing P transport to surface and ground water released on the market – no. of products	Commercialisation agreements	5 years
		New P fertiliser products that increase P efficiency by reducing soil fixation reactions (organic and inorganic) –no. products		4-5 years
		Patented P-efficient fertiliser products – no. of patents	Patents	3-5 years
	To what extent has Theme 3 produced	Extent of improved P-fertiliser management through better knowledge about P placement	Field research data	Years 3-5

Evaluation question	Monitoring questions	Indicators *Data required to address the question*	Data Source	*Frequency*
To what extent have new technologies been identified, through theme 3, to reduce non-productive losses in P-fertiliser use?	new knowledge resulting in improved on-farm P-efficiency management practices?	Extent of improved P-fertiliser management through better knowledge about timing of P use		
		Extent of improved P-fertiliser management through better knowledge about P-efficient delivery methods		
		Fieldwork completed shows significant P efficiency can be obtained through matching demand to supply by pastures		2-4 years
	To what extent have effective partnerships been formed in Theme 3?	New P fertiliser collaborations with fertiliser companies	Funding investment records Partnership agreement documents	Years 2-5
	To what extent has Theme 3 contributed to an increased understanding of ways to reduce P losses?	Feasibility of increasing P-efficiency by reducing losses to leaching or surface run-off determined	Nutrient-supply modelling data	Years 1-2
		Extent of improvement in P-efficiency of leaching products		
		Release characteristics of current fertiliser products determined	Experimental data	1-2 years
				1-2 years
		Feasibility of increasing P-efficiency by reducing P fixation determined	Experimental data	2-4 years
Theme 4				
To what extent and in what ways has the Program provided knowledge to inform future global P-supply strategies?	To what extent has engagement of policy audiences been effective?	Policy-makers develop a 'sustainable P futures strategy' for agriculture	strategy	Years 3 and 4
		Policy-makers have been provided with information on options to ensure P supply for Australia	Project records of meetings and communications with target audience/s	Years 2 and 3
	To what extent have P-risks been identified and associated mitigation strategies recommended and communicated?	Published evidence-based report on feasibility and effectiveness of demand management and re-use/supply options	Peer reviewed publication	Year 2

5. Evaluation

The following evaluation plan allows for periodic (mid-term and end of Program) assessment of the impact, appropriateness and efficiency of the Program through a set of applied research techniques to generate systematic information. This evaluation plan includes formal external, independent evaluations and 'self-evaluation processes that can help to build an internal culture of reflection and evaluation, as well as stronger ownership of the results' (IUCN 2002).

Monitoring and evaluation are two processes that often overlap and are part of a systematic learning process. The combination of monitoring and evaluation provides the knowledge required for effective program management and reporting and accountability responsibilities (DEWHA, 2008 after IFAD n.d.; & Davies 2003). The information generated through this plan will be in a format suitable for each of those purposes.

Table 5 sets out the questions to be addressed and the assessment methods to evaluate the impact the Program has had in relation to the stated objectives. A series of evaluation questions are also set out to direct assessment of appropriateness and efficiency. The evaluation will also identify unexpected outcomes. These may be positive or negative.

Much data for the mid-term and end of program evaluations will be generated internally through theme level monitoring, project/theme progress reports and annual theme-level reports addressing the monitoring questions set out in this plan.

In summary, the evaluation plan for the Program includes the above activities/reports and three independent, external evaluations – Ex-ante cost benefit analysis, mid-term and end of program. The evaluation methods are:

- Ex-ante Cost benefit analysis (CBA) in 2011 to establish benchmarks related to costs and savings and CBA at the end of Program (2016) which will make best bet assumptions about the benefits of the Program and the extent to which the knowledge produced through the Program has been adopted (or is likely to be adopted post the Program and the relative associated costs and savings to the grain industry);
- Independent mid-term review (involving internal and external stakeholders, esp. research managers and leaders) based on collation and analysis of monitoring data/evidence of progress collected through the first half of the Program and key stakeholder surveys to provide an assessment of progress towards expected outcomes;
- Independent end of program evaluation based on all data sources to assess and report on the impact of the Program (extent of change/achievement of objectives), the appropriateness of the Program activities and overall business approach and the extent to which the Program has operated efficiently, delivering value for money.

The final and mid-term reports will enhance the Program's ability to work adaptively by identifying strategies that are most effective in fostering progress toward desired outcomes and will make recommendations regarding beneficial continuing/further investment in P-use efficiency research and development activities.

Table 5: Evaluation Plan

Evaluation questions based on Program outcomes	***Evaluation purpose***	***Evaluation methods***	***Frequency***
To what extent and in what ways can/will/has the *Phosphorus Use Efficiency Program* ***increased profitability & sustainability of pasture production?***	Impact	Ex-ante CBA CBA Annual review reports	 2011 2016
To what extent and in what ways has the Program built innovation capacity among key stakeholders (producer networks, advisors, fertiliser re-sellers and plant breeders) to embrace practice change to improve P use efficiency?	Impact	Key stakeholder benchmark studies Analysis of key stakeholder event surveys + follow-up Aggregated annual report data	2011 2013 and 2016 2013 and 2016
To what extent and in what ways has the Program developed partnerships with advisors, fertiliser re-sellers, plant breeders, producers and other RDC's to capture additional funds?	Efficiency Appropriateness	Analysis of Program/collaborations and funding inputs	2016
To what extent and in what ways has each fund-contributing partner benefited from knowledge produced through the Program?	Appropriateness	Phone survey of partners	2016
To what extent has the Program produced knowledge and/tools that (can be, will be, has been) used by advisors, the fertiliser industry and governments to assist in promoting more appropriate* and greater efficiency of phosphorus use?	Appropriateness	Aggregated annual report data on new management methods/fertiliser products/patents	2013 and 2016
To what extent and in what ways has the Program demonstrated proof of concept for developing more P-efficient plants?	Impact	Aggregated annual report data on new management methods/fertiliser products/patents CBA	2013 and 2016 **2016**
To what extent have new technologies been identified, through the program, to reduce non-productive losses in P-fertiliser use?	Impact	Aggregated annual report data on new management methods/fertiliser products/patents	2013 and 2016
To what extent and in what ways has the Program provided knowledge to inform future global P-supply strategies?	Appropriateness /impact	Aggregated annual report data on new management methods/fertiliser products/patents	2013 and 2016

Evaluation questions based on Program outcomes	*Evaluation purpose*	*Evaluation methods*	*Frequency*
What were the unanticipated outcomes from the Program? (positive or negative)	Impact	Survey of policy stakeholders – round table/ focus group	**2016**
		CBA	2013-14
		CBA	2013-14
		Aggregated annual report data on new management methods/fertiliser products/patents	2013 and 2016
To what extent and in what ways has the Program effectively communicated the results of the Program to target audiences?	Appropriateness	Analysis of key stakeholder event surveys + follow-up	2013 and 2016
		Key stakeholder surveys	2016
		Aggregated annual report data on new management methods/fertiliser products/patents	2013 and 2016
In what ways could the Program have invested for greater return?	Efficiency	CBA	2016
To what extent has the Program attained the highest value out of available resources?	Efficiency	CBA	2016
		Summative end of program evaluation data	2016

6. Improvement

This MERI Plan encompasses the principles of continuous improvement in Program design and delivery. The intent is to collect the right data and information to monitor the progress towards the Program's objectives so that delivery strategies and activities can be adapted along the way to improve results and maximise desired impact.

In addition to the formal assessments to be will be held at mid-term and at the end of the Program, regular structured annual reviews will be organised to reflect on progress and what's working and what's not.

Key people to attend these workshops include:

- Program managers
- Project Leaders
- Communications personnel
- Funding partners

A 'results chart' (see template at **Attachment 2**) will be used to document data and assist both analysis of data, developing the story of progress and change and capturing learnings. The results chart will include data plotted against the logic model to illustrate progress towards outcomes.

7. Communicating results

" ….. research cannot be used unless it is available to those who might best use it, at the time they need it, in a format they can use and with findings that are comprehensible and adaptable to local circumstances . . ." (Saywell D and Cotton A, 1999, Spreading the Word, Water, Engineering, and Development Centre, Department for International Development, Great Britain).

By building communication and dissemination strategies into MERI planning, the necessary links with internal and external stakeholders, key partners and identified audiences can be established early on. A framework for developing a communications plan for the Program is at Attachment 3. The plan, once completed will illustrate how information generated through this MERI plan will be used for formal reporting and communicating with identified target audiences, including program promotions, products and stakeholder feedback.

8. MERI Budget

Building the MERI Plan	
– Program Logic	$16,000
– Stakeholder surveys-benchmarks	$10,000
Ex-ante cost benefit analysis	$15,000
Annual Review workshop facilitation and report 5 @ $6,000 each	$30,000
Mid-term evaluation	
– Independent review of annual review reports and relevant survey data	$ 20,000
Final evaluation	
– Stakeholder surveys	$15,000
– Cost benefit analysis	$15,000
– Final independent program evaluation	$35,000
TOTAL	**$151,000**

ATTACHMENTS

Attachment 2 Results chart template

Evaluation questions based on Program outcomes	Summary of actual results to date	Evidence to support summary	Comments about data quality/	Lessons learned
To what extent and in what ways can/will/has the *Phosphorus Use Efficiency Program* ***increased profitability & sustainability of pasture production?***				
To what extent and in what ways has the Program built innovation capacity among key stakeholders (producer networks, advisors, fertiliser re-sellers and plant breeders) to embrace practice change to improve P use efficiency?				
To what extent and in what ways has the Program developed partnerships with advisors, fertiliser re-sellers, plant breeders, producers and other RDC's to capture additional funds?				
To what extent and in what ways has each fund-contributing partner benefited from knowledge produced through the Program?				
To what extent has the Program produced knowledge and/tools that (can be, will be, has been) used by advisors, the fertiliser industry and governments to assist in promoting more appropriate* and greater efficiency of phosphorus use?				
To what extent and in what ways has the Program demonstrated proof of concept for developing more P-efficient plants?				
To what extent have new technologies been identified, through the program, to reduce non-productive losses in P-fertiliser use?				
To what extent and in what ways has the Program provided knowledge to inform future global P-supply strategies?				
What were the unanticipated outcomes from the Program? (positive or negative)				
To what extent and in what ways has the Program effectively communicated the results of the Program to target audiences?				
In what ways could the Program have invested for greater return?				
To what extent has the Program attained the highest value out of available resources?				

Attachment 3 Communications Plan

Who needs access to information about the progress of the project?	Type of information and format required?	Why is the information needed?	Methods for dissemination	Dates for reports/ communications