



final report

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National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers

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Contents

1	Intro	Introduction1					
2	Project Rationale3						
3	Meth	nod for Review of On-farm Tools	5				
	3.1	Key Scoping Principles	5				
	3.2	National review of on-farm tools	6				
	3.3	Evaluation of monitoring tools	7				
	3.4	Monitoring Tool Database	11				
	3.5	Review of MLA Programs and Materials	15				
4	Revie	ew of MLA Programs and Materials for Natural Resource Monitoring N	Messages 16				
	4.1	More Beef from Pastures	20				
	4.2	Tips and Tools	20				
	4.3	EDGEnetwork Courses	20				
5	Conc	clusions and Recommendations	30				
	5.1	Conclusions	30				
	5.2	Recommendations	30				
6	Refe	rerences	32				

Appendix A

Organisation Contact List



1 Introduction

Hyder Consulting was contracted by the Meat and Livestock Association on the 14th September 2006 to undertake a critique of on-farm natural resource monitoring tools available to Australian red meat producers. This project involves three key tasks, including:

- A national review of natural resource monitoring tools available to red-meat producers;
- A review of MLA programs and materials for natural resource monitoring messages; and
- Undertaking a critique of the available monitoring tools and incorporate findings into MLA programs and materials.

The report is structured according to the following key sections:

- Section 2 outlines the rationale for the project.
- Section 3 provides information regarding the methodology applied to critique on-farm natural resource monitoring tools.
- Section 4 identifies key findings from the critique and recommendations for incorporation of these into MLA programs and materials.
- Section 5 outlines key conclusions and recommendations which can be drawn from the project.



2 Project Rationale

The integration of natural resource management (NRM)¹ principles into agricultural production systems is increasingly recognised as fundamental to achieving sustainable land and water management. . Sound NRM improves the natural resource base (land, water, biodiversity), contributing to increased productivity and enabling producers to respond to community demand for environmentally friendly production systems. Certain markets favour agricultural products that have been grown in an environmentally friendly manner – organic or free range meat, and chemical free fibre such as wool are now commonly marketed with premium prices. Australian primary producers are also becoming increasingly aware that one of the competitive advantages they can develop is a 'clean and green' image and label.

Meat and Livestock Australia (MLA) currently manages an on-farm Quality Assurance Standard program known as the Livestock Production Assurance (LPA) Quality Assurance Standard. This program provides the framework for producers to readily adopt quality assurance systems. The MLA is investigating the potential for developing an optional Environmental Quality Assurance module as part of the LPA framework. This initiative is to assist red meat producers gain recognition for responsible on-farm environmental management. Monitoring of natural resources on farm enables producers to assess their own environmental performance to demonstrate contributions toward environmental improvements.

A significant number of natural resource monitoring tools are currently available to red-meat producers from a diverse range of sources including red-meat producers themselves, agricultural agencies, research and development corporations, regional NRM bodies, Landcare organisations and universities. This study involves assessing and collating an inventory of tools from these sources so that they can be applied specifically to on farm landuse management. This information maybe directly related to resource productivity e.g. monitoring pasture biomass to optimise utilisation rates and monitoring threats e.g. weed abundance in native pasture so that appropriate management action can take place.

Red-meat producers can also use natural resource monitoring information to demonstrate sound environmental management practices. As environmental stewards, producers management practices directly influence the natural resource base upon which they are dependent. Increasingly the community is questioning these management practices across the agricultural sector. NRM monitoring information can be used to substantiate good management practices and build greater credibility in the agricultural sector.

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers Page 3

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¹ Natural resource management involves integrated sustainable resource management of land, water and biodiversity to achieve improved outcomes which meet community expectations.



3 Method for Review of On-farm Tools

The national review and critique of on-farm tools involved a number of key objectives, including:

- To conduct a national review of natural resource monitoring tools available to Australian red meat producers;
- To provide a critique of the available monitoring tools based on resources, spatial relevance, practicality, accuracy and readiness for use, and suggest tools that MLA could incorporate into its programs and materials for natural resource monitoring; and
- To undertake a review of MLA programs and materials for natural resource monitoring messages.

The methodology developed by Hyder to meet the objectives identified above is described in detail below in Sections 3.1-3.5.

3.1 Key Scoping Principles

There is a wide range of electronic and printed literature on research methods, tools, models, guidelines, fact sheets, programs and projects regarding on farm natural resource management. The vast majority of these NRM products have been developed for specific purposes. In many instances these specific purposes relate to particular reporting needs such as those developed for government programs, for particular agroclimatic regions such as the rangelands or tropical pastures or those developed for specific production needs such as those for grower groups. Few tools have been developed for generic application due to the time, cost and complexity of doing so. There are many examples where specific methods or approaches have been grouped together to provide a package that has been applied for a specific purpose. Monitoring of rangeland condition, forest habitat or riparian vegetation are such examples where information is collected on plant abundance, plant diversity, vegetation structure and vegetation function using a suit of different methods.

This project aims to make explicit the intended application of the monitoring tool as well as its potential use by existing MLA programs and materials.

Many NRM tools that were encountered but not included were developed for single point in time projects or for resource condition status assessment or large programs or research efforts that have application for research investment or policy advice. Many tools encountered have also been established to assess the effectiveness of NRM related works undertaken such as revegetation or erosion control. To adequately scope this project it was necessary to develop some pragmatic guidelines. At project inception these key scoping guidelines were developed in liaison with the MLA's project manager, Malcom Sedgewick and include the following:

 The tool must have direct application for on-farm landholder management;

Page 5 Hyder Consulting Pty Ltd

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



- The tool must be designed for on-going natural resource monitoring rather than status assessment; and
- The tool must be capable of delivering measured data in relation to natural resource condition.

These scoping guidelines have been used as initial screens for the selection of suitable tools for the evaluation process (See Section 3.3). This process ensured that the most relevant tools to land managers were included in the inventory.

There are a number of tools that have not been included in this review for the above reasons. Some examples and reasons for exclusion include:

- Queensland Department of Primary Industries and Natural Resources Aussie GRASS model. This tool is based on modelled data rather than data obtained via direct measurement by landholders.
- NSW Department of Primary Industries GrassGro. This tool is a decision support system.
- Northern Territory Rangeland Remote Sensing Monitoring. The methods can not be directly applied by landholders.

During the phone consultations it was discovered that there are a number of monitoring tools that are currently under development. This review has not included these as no information is currently available to producers. These include monitoring tools such as the Land and Water Australia Quickchecks which will consist of a series of monitoring proformas for wool growers to monitor natural resource condition such as riparian vegetation, biodiversity, pasture and soils. Land and Water Australia is also soon to release monitoring tools under the Saline Lands sub-program.

3.2 National review of on-farm tools

Hyder initially identified a comprehensive list of organisations as potential custodians of natural resource monitoring tools which could be applied by red meat producers for measuring on-farm natural resource condition. Key organisations included the following:

- Australian state government agriculture agencies, e.g. Department of Primary Industries Queensland, Victoria and NSW
- Grower or Agricultural best practice groups such as the Kondinin Group
- Regional catchment management authorities and bodies
- Research organisations such as CSIRO and Grains Research and Development Corporation
- Landcare co-ordinators
- Universities

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



A list of tools which Hyder had access to was initially added to the inventory. An in-depth web search was also undertaken for a range of organisations to identify a comprehensive suite of on-farm monitoring tools.

Targeted consultation was also undertaken with key agencies through telephone interviews and feedback forms to identify any additional tools which may not have been included within the initial inventory. The interviews and feedback forms were also used to resolve any information gaps and to verify the validity of information in the database. Twenty-six key personnel were contacted from a number of key organisations including:

- Department of Primary Industries, Victoria and NSW
- Department of Primary Industries and Water, Tasmania
- Department of Natural Resources and Water, Queensland
- CSIRO
- Department of Sustainability and Environment, Victoria
- The Kondinin Group
- Agriculture, Western Australia
- Australian Government Bureau of Rural Sciences.

The targeted consultation exercises resulted in the inclusion of six additional tools as well as the verification and updating of information in the tools already included in the database from those organisations. Records of this consultation exercise are summarised in Appendix A.

3.3 Evaluation of monitoring tools

The key objective for evaluating the monitoring tools was to assess the usefulness of the tools in providing producers with management information to enable them to assess the impact of their own management actions on various components of the natural resource base e.g. the outcome of a particular grazing regime on the vegetation or soil condition.

It was considered that this approach would assist producers in identifying tools which can assist them in demonstrating, through monitoring, responsible environmental management. Examples of questions which a producer may be asked in order to demonstrate environmental stewardship may include:

- How is your management maintaining or improving biodiversity values?
- How is/ and or has your management contributed to maintaining or improving native vegetation condition and/or extent?
- How is your management maintaining or improving land health?

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



• How is your management maintaining or improving water quality and/or water availability?

There is a wealth of literature regarding on-farm natural resource management. This literature covers topics such as:

- Guidelines for management practices such as sustainable grazing, conservation farming, farm planning and farm water supplies
- Guidelines for establishing NRM projects or programs including monitoring systems
- Guidelines for NRM related activities such as remnant vegetation fencing, rabbit ripping, weed control
- Inventory or baseline assessment of resource condition such as forest condition, mapping native vegetation extent and condition or soil type extent and hazard.

This project is concerned with tools for on going monitoring of natural resources, which have a proven track record in on-farm application. For example it does not include tools for evaluating the effectiveness of particular projects such as tree-planting, revegetation or a rabbit ripping project.

To focus only on those relevant and suitable tools, a number of criteria were applied to the potential monitoring tool to screen unsuitable tools. These criteria include:

- 1 Has the tool been developed for on-property application i.e. it is not a research tool?
- 2 Has the tool been developed for on-going monitoring of natural resources rather than a one-off status assessment?
- **3** Is the tool used for capturing measured data as opposed to modelled or simulated data?

The components of environmental stewardship, identified in the questions above, are likely to be more tangible to red-meat producers through monitoring programs which link directly to management practices. For each of the tools which passed the initial screening process and gained inclusion in the inventory the following information was collated:

- Natural resource base which the tool provides measured data against. Information collected maybe used for multiple purposes. For example, a tool utilised by a producer to monitor native pasture composition will also provide information which enables them to determine the effect of their land management practices upon native vegetation and biodiversity.
- Production system type in which the tool is commonly used. There
 are several examples where monitoring tools have been specifically
 developed for a production system type, for example in semi-arid
 areas the importance of chenopod shrubs for pastoral production has
 lead to the development of specific techniques for measuring their



productivity. Alternatively a tool used for monitoring soil moisture could be applied across all relevant production systems (native pasture, improved pasture and agricultural land)

- Land management information addressed i.e. is the tool used for resource productivity or threat reduction. The key natural resource monitoring attributes for these categories are presented in the table below.
- Type of information generated by tool i.e. qualitative such as photos or quantitative data such as pasture biomass.
- Optimal monitoring frequency for application of monitoring tool in order to generate useful management information. Some tools require seasonal application while others require less frequent application.

Land Management Information Requirements	Natural Resource Monitoring Attributes			
Resource Productivity	 Groundcover Pasture biomass Pasture composition 			
	 (desirable perennials) Soil stability(erosion) Soil moisture Soil nutrients (N,P) Water quality 			
Threat Reduction	 Water quality Tree cover Pasture composition (weeds) Regeneration of native 			
	vegetation Tree decline Salinity Acid sulphate soils Total grazing pressure			
	 Feral animals 			

Table 1: Examples of land management information requirements and natural resource monitoring attributes

In addition to the above information organisational contact details and references were also collated for each of the tools included in the inventory.

Multi-Criteria Assessment

A multi-criteria assessment framework was developed to assist in determining which tools were likely to be most effective in assisting producers to demonstrate responsible environmental stewardship.

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



Five key categories were developed for the critique of tools included in the inventory. A scoring system of 4, 2, 1 was applied with 4 reflecting the highest score and 1 the lowest for a specific category. Key categories and their corresponding criteria for assessment are presented below:

- 'Practicality' relates to the ease of understanding and application of a specific tool for on-farm use. The timescales required for a tool to deliver management useful information also links to this category. Key criteria for assessment include the following:
 - 4 Straight forward in method and application and can deliver management useful information over short time-frame i.e. season
 - 2 Some complexity in understanding method but can deliver information in a useful management time-frame
 - 1 Complex in understanding and/or timeframe and/or delivers over timeframes which are less practical
- 'Resources' are also an important category for assessing the usefulness of monitoring tools for on-farm application. Resources, for the purpose of this critique are comprised of dollars, human resources and equipment. Key criteria for assessment include the following:
 - 4 Low inputs of all categories of resources
 - 2 Medium inputs of all resources
 - 1 High inputs of all resources
- 'Accuracy' relates to the confidence in reliability of measured data produced by a tool based upon relevance for intended purpose. Key assessment criteria include:
 - 4 High data generated from laboratory analysis or rigorous, well tested field methodology
 - 2 Field level accuracy not well tested
 - 1 Low Limited interpretation of data available due to method type or low accuracy i.e. presence or absence data
- 'Readiness for use' relates to the ability of a producer to use the tool for immediate on-farm application. Key assessment criteria include:
 - 4 Access necessary information now and apply immediately
 - 2 Some additional information needed from other sources before application



- 1 Low availability of information now as well as other resources required for application
- 'Spatial relevance' highlights the importance of a monitoring tool to generate information at a scale which is relevant to land management. For the purpose of this evaluation it was considered that the most appropriate scale of monitoring was at the property or paddock level. Key assessment criteria include:
- 4 High relevance to management at scale which info collected and tool applied
- 2 Has some but limited relevance to management at scale at which information is collected
- 1 Does not have relevance to management at scale at which information is collected

Each of the tools included in the inventory was scored against the criteria for each of the categories identified above. The maximum score a tool could score was 20. This approach was used as a 'ready reckoner' to determine which tools are likely to be most effective for producers.

3.4 Monitoring Tool Database

A Microsoft Access database was developed to include the on-farm natural resource monitoring tools reviewed. The database includes a 'tools register' function to ensure that information could be consistently collated across a number of key areas for new tools reviewed as well as providing the MLA with the ability to update the database in the future as new tools are developed. It also includes a 'tools search' function primarily aimed at meat and livestock producers to allow easy access to tools specifically relevant to each producer. The opening page of the monitoring tool database is outlined in Figure 1 below.



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Figure 1: Opening page of MLA's NRM monitoring tool database

Registering Tools

The 'tools register' function is primarily designed for the MLA (or other tool developers) to register new tools as they become available or update existing tools. Registering and adding tools to the database is completed by providing the following key information:

- General tools information: This contains name, description, reference, state applied to, organisations which developed the tools and contact within the organisation.
- Natural Resources Base: This shows the application of tools across the five natural resource assets - soil, vegetation, water, fauna and atmosphere
- Production System Type: This demonstrates the type of production system that the tool is commonly used for e.g. native pasture.
- Land Management Information Addressed: This relates to the land management information requirements that the tool addresses e.g. groundcover, pasture biomass, soil salinity and water quality etc. Tools tend to fall into categories linked to resource productivity as well as those that relate to threat abatement.
- Optimal Monitoring Frequency: This is used for the application of the monitoring tool to generate management I information.
- **Type of Information:** This is the type of information generated by the tools i.e. quantitative and qualitative.
- Tool Evaluation Score: This shows the score of tools against five key criteria categories i.e. practical, resources, accuracy, readiness for use



and spatial relevance. The best possible score is 20 based on a maximum score of 4 for each of these categories.

The above aspects reflect the core components of the database and are illustrated in Figure 2.



Figure 2: Key components of MLA's on-farm natural resource monitoring tool inventory

Registering key component information for each tool is easily completed by filling out the 'tools register form' within the database. A screenshot of this form is shown below in Figure 3.

Tools Registe	IF			nla
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Figure 3: NRM monitoring tool register form

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers Page 13



Searching for tools

The database also includes a multiple search function which can be used by a variety of audiences including producers, government organisations, state catchment management organisations and agricultural research and development corporations. Using this function, they can identify relevant tools by selecting a relevant option within the following key categories:

- Natural Resource Base: This searches the tools database according to subject within natural resource management e.g. land, water, vegetation etc.
- Land Management Information: This searches the database according to the land management information addressed by each tool. For example, a producer who wishes to identify tools that assist in implementing targets for livestock nutrition requirements may be interested in identifying tools that measure pasture biomass or soil fertility.
- Production System Type: This will search the database according to the production system e.g. agricultural lands.

ack to Start Page		SAT & LIVESTOCE AUDITORS
Natural Resources Base	Land management in	formation addressed
Sell	Groundcover	Pasture Composition (weeds)
Vegetation	Pasture Biomass	Regeneration of native vegetation
Water	Pasture composition (destrable perennials)	Trae decline
Fauna	Soli Stability	Salinity
Atmosphere	Soll Moisture	Acid sulfate sells
Production System Type	Soll Nutrients	Total grazing pressure
Native Pasture	Water Quality	Feral animals
Improved Pasture	Water Quantity	
Anricultural Land		

A screenshot of the multiple search function is shown below in Figure 4.

Figure 4: NRM Tool search function

When a category is chosen, the database searches relevant tools and lists them in descending order according to the evaluation ranking. Furthermore, the database is also able to produce reports for specific tools containing information according to the key categories illustrated above in Figure 2.

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



Each tool was assigned a unique identification number within the database to enable linkages to recommendations of tools that will complement or fill gaps identified in existing MLA programs and materials.

3.5 Review of MLA Programs and Materials

A review of MLA programs and materials was undertaken to identify the potential for improvement of natural resource monitoring messages in line with the outcomes of the critique of on-farm monitoring tools. Key programs and materials which were reviewed included:

- More Beef from Pastures
- Tips and Tools
- Edge Network Courses
 - 1. Grazing Land Management
 - 2. Healthy soils, healthy profits
 - 3. Profit from saline lands
 - 4. Managing living systems
 - 5. Weed removers, pasture improvers
 - 6. Wean more lambs
 - 7. Breeding edge/effective breeding
 - 8. Northern nutrition
 - 9. Prograze
 - BeefCheque
 - LambCheque

As part of this review Hyder completed a 'gap analysis' of MLA resources and to fill any gaps with information regarding best available monitoring tools.

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4 Review of MLA Programs and Materials for Natural Resource Monitoring Messages

Natural resource monitoring can play an important role in achieving and managing sustainable production systems. The integration of a number of monitoring tools covering different aspects of the natural resource base can provide a holistic picture of on-farm condition. Therefore, it is important that MLA extension programs provide producers with appropriate information and directions to ensure that they can gain the necessary information concerning monitoring tools.

Review of the existing MLA programs and materials for natural resource monitoring messages is aimed at providing some guidance for value adding or enhancing the value of the programs and materials. The main criteria for this review are:

- What NRM monitoring tools that have been evaluated could compliment the program/material/message?
- What other key complimentary messages could be added to the existing messages?
- What are the key gaps that may exist in respect to monitoring tools for each of the programs/materials?

Monitoring involves regular standardised observations at consistent points to gain knowledge for management. Natural resource monitoring tools are most useful when applied in a consistent fashion over long periods of time with many observations. The type of management information or knowledge that is required will determine the monitoring approach taken, the methods used, the frequency and spatial distribution of observations and the accuracy of the data collected.

The above needs to be considered when matching existing NRM monitoring tools to existing programs that may have different purposes.



MLA Program	Section reference	MLA Objective	Land Management Information Addressed	Recommendations
More Beef from Pastures	4.1	The key objective of this document is to ensure optimal pasture growth and use to achieve an appropriate balance between productivity, sustainability and profitability.	Groundcover, pasture biomass, Water Use Efficiency (WUE), soil quality, salinity and soil moisture.	NRM and production issues should be viewed holistically i.e. not independent of one another.
Tips and Tools	4.2	Two main themes – pasture management (Provision of knowledge on pasture dynamics and the plant animal interaction) and natural resource management (Provision of knowledge to maintain condition or prevention of degradation).	Pasture abundance, quality, growth, ground cover, biodiversity, native vegetation value and condition assessment.	Telling of a bigger picture of the importance of the integration of NRM in sustainable production systems. More direction for producers to gain monitoring information. Better integration of the existing tools.
Grazing Land Management	4.3	Aims to improve management of grazing lands in Northern Australia through application of appropriate on-farm management strategies. Aims to develop a detailed understanding of the grazing ecosystem through exploring the main drivers for grazing lands as well as key factors which maintain their productivity. Involves three key themes including land condition (conversion of rainfall into useful pastures), evenness of grazing	WUE, groundcover, biodiversity, soil quality, soil moisture, pasture biomass and pasture composition	Improve integration of existing monitoring tools. This is achieved through the development of a monitoring tool box to accompany workshop participant notes. Tools are segregated according to those that link to productivity as well as those which link to threat reduction. For example, visual assessment techniques such as photo-point monitoring are useful for assessment of land condition as well as for monitoring annual pasture growth
Healthy soils.	4.3	(pasture utilisation) and diet (conversion of pasture to beef). Focus on what is	Infiltration.	Additional indicators of soil health

Table 2: Summary of review of MLA programs and materials

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



MLA Program	Section reference	MLA Objective	Land Management Information Addressed	Recommendations
healthy profits		happening underground on-farm and how to improve profitability and sustainability of grazing systems by improving soil health.	seedling growth comparisons, microbial activity comparisons, groundcover	 e.g. soil nutrients could be included within this program. A monitoring toolbox can be developed to support measuring of indicators. A simple scoring system can be developed for each of the key attributes of soil health. A pro-forma can included in workshop participant notes to score soil health on a paddock by paddock basis.
Profit from saline lands	4.3	Two main themes – provide participants with understanding of how to identify saline landscapes as well as how to establish and maintain productive pastures on saline landscapes.	Salinity, water quality, water quantity, pasture composition, groundcover	Develop simple step-wise approaches for monitoring key salinity aspects including, soil, water, vegetation, groundwater height. A paddock pro-forma can be developed for recording field data. A toolbox including relevant universal techniques for monitoring salinity can be developed.
Managing living systems	4.3	Aims to provide producers with tools to recognise attributes of on-farm biodiversity, particularly for native vegetation, pastures and riparian zones. Also aims to assist producers in developing management regimes which strike an optimal balance between profitability and biodiversity.	Tree decline, regeneration of native vegetation, tree cover, pasture composition, riparian condition.	Include additional information regarding threatening processes which can potentially impact upon biodiversity. Develop lists (including photos) of key weeds, feral animals etc which are relevant to workshop region. Include additional techniques for undertaking ongoing monitoring of biodiversity attributes in addition to rapid assessment techniques.
Weed removers, pasture improvers	4.3	Provides tools to assess pasture composition and a range of management strategies which aim to improve pasture quality.	Pasture composition, groundcover	Include photographs of common weeds relevant to workshop region to assist in identification of weeds.
Wean more lambs	4.3	Highlights the importance of reproductive efficiency in terms of profitability of all sheep flocks. Identifies a range of management activities to optimise flock	Pasture biomass	Update to include messages regarding the importance of pasture quality as a driver for improving sheep flock reproductive efficiency Identify suite of monitoring tools which could be used to assist in

Page 18



MLA Program	Section reference	MLA Objective	Land Management Information Addressed	Recommendations	
		reproductive capacity by integrating nutrition and flock reproduction targets.		characterising pasture quality and growth.	
Breeding edge/effective breeding	4.3	Central objective involves optimisation of breeding herd performance. The program identifies strategies and best management practice to ensure that this objective is met.	Pasture biomass, pasture composition, soil fertility	No monitoring tools are identified within the workshop notes. A monitoring tool box could be developed to accompany participant notes. Tools could be sorted according to those which link to productivity as well as those which link to threat reduction	
Northern nutrition (Nutrition Edge)	4.3	Central theme focuses on the key concepts of grazing management and its relationship to cattle	Soil quality, soil moisture, pasture biomass,	Clear identification of relevant linkages (through cross-referencing) to other relevant EDGEnetwork programs.	
		nutrition.	pasture composition	Broaden the scope of this workshop to include additional regions e.g. southern.	
				Develop a toolbox including relevant universal techniques for monitoring pasture growth and utilisation.	
PROGRAZE	4.3	Pasture and livestock management program which provides producers with information on how to assess animal and pasture productivity, set production targets, using monitoring throughout the process to support decision making.	Pasture biomass, pasture composition, groundcover	A monitoring tool box could be developed which addresses all aspects governing pasture quality. Tools could be sorted according to those which link to productivity attributes as well as those which link to threats	
BeefCheque / LambCheque	4.3	To achieve adoption of improved grazing management.	Pasture biomass, pasture composition, pasture cover, soil fertility	A monitoring tool box could be developed which addresses all aspects governing pasture quality. Tools could be sorted according to those which link to productivity attributes as well as those which link to threats	



4.1 More Beef from Pastures

The More Beef from Pastures program contains a number of modules are essential in setting the overall strategic direction of a beef enterprise located in southern Australia. The maintenance of pasture quality and quantity is identified as a fundamental component governing the overall success of any beef operation. Modules 3 and 4 of the More Beef from Pastures package outline a number of easy to use monitoring tools including assessing soil texture, identifying waterlogged and salt affected soils, measuring water use efficiency, undertaking field based pasture measurements (including pasture composition and groundcover) and determining pasture biomass and growth rates. These tools tend to address attributes which link either to resource productivity (e.g. pasture biomass) or threat reduction (salinity). An understanding of baseline information (basic systems understanding) for each of these key performance indicators will ensure that producers have the necessary knowledge to make informed decisions which enable them to fulfil objectives relating to productivity, sustainability and profitability.

4.2 Tips and Tools

The Tips and Tools package provides useful information for producers on the essential "what" and "how" of key topics such as pasture quantity and quality estimation, growth and recovery from drought, biodiversity and natural vegetation. The information provided is very factual and by necessity generic.

The Tips and Tools package provides the baseline principle understanding and when combined with relevant monitoring tools enables producers to translate these principles into their own specific circumstances. For example the "Managing groundcover to reduce runoff and water loss" tips and tools sheet lists general principles such as in Autumn maintaining 800kg/ha of dry feed to ensure at least 70% of ground cover. This will vary considerably according to the location and pasture type. The tips and tools sheet importantly draws the relationship between biomass and groundcover to the producer and why groundcover is important for moisture retention. With this baseline understanding, through using relevant tools to enable the producer to monitor pasture biomass and groundcover over different land types (soil and vegetation combinations) on the property, the producer will quickly learn the range of this relationship relevant to them and how to manage for it.

4.3 EDGEnetwork Courses

The MLA has developed a number of useful NRM and production extension programs which focus on providing land managers with the ability to gain



new knowledge and develop skills to improve land management practices. Key courses include the following:

- 1. Grazing Land Management
- 2. Healthy soils, healthy profits
- 3. Profit from saline lands
- 4. Managing living systems
- 5. Weed removers, pasture improvers
- 6. Wean more lambs
- 7. Breading edge/effective breeding
- 8. Northern nutrition
- 9. Prograze
 - BeefCheque
 - LambCheque

The courses identified above use practical workshops, farm walks, group discussions (generally no more than 15 landholders) and projects to provide landholders with additional knowledge in relation to land management practices. Therefore, the EDGEnetwork courses provide a useful platform for promoting the importance of monitoring as a mechanism for providing landholders with an improved understanding of on-farm natural resource condition. For example the grazing land management

Table 3 includes a list of tools (compiled from the national review of on-farm tools) which could complement and improve existing MLA programs and materials.

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Table 3: Review of MLA NRM programs and materials to identify additional NRM messages

Component Description	Other useful complementary monitoring tools available (scores >13)	Other potential messages	Gaps	Useful tools available to fill gaps (scores > 13)	Comments
More Beef from Pastures: Module 3 Pasture Growth – importance of measuring various attributes such as groundcover to ensure optimal pasture growth as well as key risk factors including erosion and salinity.	12, 13, 15, 19, 25, 42, 45, 5, 17, 34,43, 35, 39	Pasture quality and quantity is influenced by the integration of a diversity of attributes including rainfall, temperature, management practices, soil nutrient availability, moisture	 Importance of monitoring, other natural resource components other than vegetation and the water cycle. Although monitoring of soil condition is referred to in procedure 3 it should be better linked to tools 3.8 and 3.9 e.g. instructions on how to monitor soil phosphorus and nitrogen. This can provide producers with useful information when determining required fertiliser application rates. Monitoring changes in native vegetation to determine risks and opportunities in relation to available pasture. 	35, 44, 46, 51, 14,	The importance of natural resource condition monitoring in achieving targets relating to productivity, sustainability and profitability for beef enterprises could be made more implicit in module 1 'setting directions'. Monitoring tools could be arranged according to those which link to productivity as well as those which assist in minimising threats.
More Beef from Pastures: Module 4 Pasture Utilisation – includes a number of procedures to ensure best utilisation of pasture to	4, 6, 7	It is important to recognise that pasture biomass reflects the interaction of a number of factors such as soil, temperature, groundcover, water availability etc. Monitoring these attributes will ensure	 Methods for assisting producers to determine the composition of pastures i.e. desirable native grasses vs weeds Methods for estimating pasture groundcover 	13, 15, 19, 51, 43	Monitoring tools could be arranged according to those which link to productivity as well as those which assist in minimising threats.

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



Component Description	Other useful complementary monitoring tools available (scores >13)	Other potential messages	Gaps	Useful tools available to fill gaps (scores > 13)	Comments
meet desired production levels		that management practices are well informed. Monitoring can provide increased objectivity and understanding of the process of making logical decisions on fertiliser applications			
Tips and Tools: Feedbase and Pastures – estimation of pasture biomass, pasture growth, quality, feed days, pasture survival and recovery.	13, 15, 19, 25, 51	Learn more about the unique factors that influence your pastures by monitoring and recording changes and relating them to rainfall, management, soils and pasture type.	Explanation of the plant animal interaction i.e. grazing effects on plant growth.	13, 15, 19, 51, 57, 58	The tips and tools may be sequentially ordered as a "story". The story is one of the factors for plant growth, survival, grazing and return to soil.
Tips and Tools: Natural Resource Management – Importance of managing different natural resource components including groundcover, native vegetation and biodiversity.	7, 12, 19, 44, 46, 51	Natural resources are integrated – the components (soil, water, air, vegetation) do not operate in isolation.	 The basic relationship between natural resource health (and productivity) and the capacity to harvest this as fibre, meat or grain. It is the health of the processes that determines the health of the components. Monitoring gives us some idea of the health of these processes. Current natural resource management components limited to natural vegetation, biodiversity and the water 	5, 42, 44, 35, 39, 58	Here also maybe the tips and tools should be part of an integrated story. Natural resources could also be organised by key assets influencing productivity as well as key threats.

Page 23

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



Component Description	Other useful complementary monitoring tools available (scores >13)	Other potential messages	Gaps	Useful tools available to fill gaps (scores > 13)	Comments
			cycle.		
Grazing Land Management - Uses GRASP (grass production model) to estimate pasture growth. Identifies importance of monitoring pasture quality/quantity, groundcover, soil nutrients, soil moisture, native vegetation and weed presence. However, no tools are identified within the workshop notes	4,6,12, 13, 14, 15, 19, 25, 35, 38, 43, 45, 46, 51, 52, 56	Natural resources are integrated – the components (soil, water, air, vegetation) do not operate in isolation. Monitoring these components will ensure that management practices are better informed.	 No supporting monitoring tools included in workshop notes Importance of monitoring threats in addition to weeds which can impact on pasture quality i.e. erosion and salinity The tool is modelled data – it requires calibration with local data. 	5, 42, 44, 35, 39, 58	No monitoring tools are identified within the workshop notes. A monitoring tool box could be developed to accompany participant notes. Tools could be sorted according to those which link to productivity as well as those which link to threat reduction
Healthy Soils, Healthy Profits – water infiltration test within soil pit profile, seedling growth comparisons and microbial activity comparisons. Workshop also includes two soil	13, 15, 25, 43, 45	Soil health is the outcome of a complex interaction of attributes including presence/absence of native vegetation, biodiversity and management practices. Soil moisture, nutrients, water use efficiency, soil stability, soil pH, type,	 Importance of monitoring other indicators of soil health, including moisture, nutrients, earthworms, soil pH, leaf colour, root structure and texture. The quality of sub-soil, particularly in relation to nutrients is also an important indicator of soil health. 	14, 35, 38, 46, 52, 56,	Additional indicators of soil health e.g. soil nutrients could be included within this program. A monitoring toolbox could be developed to support measuring of indicators.

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Page 24



Component Description	Other useful complementary monitoring tools available (scores >13)	Other potential messages		Gaps	Useful tools available to fill gaps (scores > 13)	Comments
tests within 2 of the participants paddocks.		texture, presence of earthworms, leaf colour are all key indicators of soil health. Monitoring of these attributes can sustain and improve enterprise productivity over the long-term.	•	Presence/absence of salinity and erosion are also key indicators of soil health.		A scoring system could be developed for each of the key attributes of soil health. A pro-forma could be included in workshop participant notes to score soil health on a paddock by paddock basis.
Profit from Saline Lands – outlines methods for measuring various indicators of saline landscapes including plant indicators, groundwater height and quality.	4, 5, 6, 35, 42, 45, 34, 37, 51, 56, 58	Monitoring of saline landscapes can provide information which can facilitate transformation of unproductive land into more productive land, increasing profitability of beef, wool and lamb enterprises.	•	Minimal information regarding supporting monitoring tools for monitoring indicators of saline landscapes. Photo-point monitoring can be a useful method for assessing saline landscapes e.g. monitoring regression of or increases in saline affected areas Risk of leakage Salinity tolerance thresholds for	12, 39, 51,	Develop simple step wise approaches for monitoring key salinity attributes including, soil, water, vegetation, groundwater height. A paddock pro- forma could be developed for recording field data. A toolbox including relevant universal
				different pasture types expressed in terms of EC.		techniques for monitoring salinity could be developed.
Managing Living	35, 55	Biodiversity can improve productivity	-	processes which can impact on	4, 6, 7, 51	Could include lists and



Component Description	Other useful complementary monitoring tools available (scores >13)	Other potential messages	Gaps	Useful tools available to fill gaps (scores > 13)	Comments
Systems – rapid assessment techniques for native bushland, native pastures and riparian zones.		and long term sustainability of farming enterprises.	 biodiversity e.g. removal of native trees, feral animals and weeds Regular on-farm monitoring of biodiversity attributes e.g. native vegetation is also important 		photographs of common threats to biodiversity for each workshop locality
Weed Removers, Pasture Improvers – methods for assessment of pasture composition include PROGRAZE stick, transects, quadrats, motorbike method, quadrat and the 'Blundstone' method	4, 15, 25, 51	The amount of desirable pasture species that a paddock is capable of supporting is influenced by a number of factors including grazing pressure, drought, salinity, acidity and feral pests. Early identification of weeds can ensure that practices to improve pasture quality are well informed.	 Photo-point monitoring may also be useful method for determining composition of native pastures Rapid diversity assessment techniques are also a simple technique for undertaking quick assessments of pasture composition. Photos depicting common types of weeds relevant to workshop area. 	6, 25, 51	Include photographs of common weeds relevant to workshop region to assist in identification of weeds.
Wean More Lambs – methods for assessment of pasture biomass	13	High quality pastures can improve sheep flock reproductive efficiency and overall productivity. Monitoring key limiting factors of pasture growth is an essential component of best practice grazing management.	 The basic relationship between natural resource health (and productivity) and the capacity to harvest this in the form of wool or meat. Pasture growth is determined by the complex interaction of a diversity of factors in addition to climate including soil, groundcover, soil moisture, water availability 	4, 6, 12, 14, 25, 35, 44, 45, 46, 51, 56	Update to include messages regarding the importance of pasture quality as a driver for improving sheep flock reproductive efficiency Identify suite of monitoring tools which could be used

Page 26

Hyder Consulting Pty Ltd ABN 76 104 485 289

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



Component Description	Other useful complementary monitoring tools available (scores >13)	Other potential messages	Gaps	Useful tools available to fill gaps (scores > 13)	Comments
			 Methods for comprehensive assessment of pasture including pasture composition, groundcover, soil fertility 		to assist in characterising pasture quality and growth.
The Breeding EDGE: Module 6 - identifies importance of acquiring knowledge regarding environmental constraints e.g. rainfall, as well as importance of assessing quality of pasture available. The document does not include any information on how to assess these factors, nor does it provide links to other relevant MLA programs/materials.	13	Learn about key elements of your farm environment that can enhance or impact on the quality of feed available for a breeding herd by monitoring and recording changes and relating them to rainfall, management, soils and pasture type Monitoring of farm natural resources which link to productivity and threat abatement will help to ensure that tactics and strategies for managing nutrition in a beef enterprise are well informed.	 The basic relationship between natural resource health (and productivity) and how optimisation (or getting the balance right) can enhance sustainability and profitability. Methods for assessment of factors which influence productivity i.e. pasture biomass, pasture composition, groundcover, soil quality. Methods for assessment of factors which can impact on productivity (threats) e.g. salinity, erosion 	4, 5, 6, 12, 14, 25, 34, 35, 43, 44, 45, 46, 51, 56, 57, 58	No monitoring tools are identified within the workshop notes. A monitoring tool box could be developed to accompany participant notes. Tools could be sorted according to those which link to productivity as well as those which link to threat reduction
Northern Nutrition: Modules 2 and 3 - highlights importance of monitoring pasture quality/quantity. Other key	4,6,12, 13, 14, 15, 19, 25, 46, 56, 14	A good understanding of farm environmental and ecosystems is required to effectively manage and manipulate the supply of nutrients from pasture. Monitoring is an	 Minimal information regarding supporting monitoring tools for monitoring pasture quality and quantity. Methods for assessment of factors 	5, 34, 39, 42, 44, 45, 56	Clear identification of relevant linkages (through cross-referencing) to other relevant EDGEnetwork

Page 27



Component Description	Other useful complementary monitoring tools available (scores >13)	Other potential messages	Gaps	Useful tools available to fill gaps (scores > 13)	Comments
factors limiting pasture growth include soil nutrients, soil moisture and native vegetation. Minimal tools that can assist in monitoring the above attributes are identified within the workshop notes		important tool for promoting understanding of these components. Learn more about the unique factors that influence your pastures by monitoring and recording changes and relating them to rainfall, management, soils and pasture type.	which can impact on pasture availability and quality e.g. salinity, erosion		programs. Broaden the scope of this workshop to include additional regions e.g. southern. Develop a toolbox including relevant universal techniques for monitoring pasture growth and utilisation.
PROGRAZE – estimation of pasture biomass, pasture composition, groundcover, soil fertility	4, 6, 13, 38, 46, 53, 56	Learn more about the unique factors that influence your pastures by monitoring and recording changes and relating them to rainfall, management, soils and pasture type. Key factors that limit the productivity of pastures include soil fertility, drought, weeds, salinity, acidity, low levels of on-farm biodiversity Monitoring key limiting factors of pasture growth e.g. pasture composition is an essential	 Methods for assessment of groundcover, soil structure, texture etc., water use efficiency Methods for assessing processes which can impact on pasture quality e.g. salinity 	5, 12, 14, 15, 34, 43, 44, 45, 57, 58	A monitoring tool box could be developed which addresses all aspects governing pasture quality. Tools could be sorted according to those which link to productivity attributes as well as those which link to threats.

Page 28



Component Description	Other useful complementary monitoring tools available (scores >13)	Other potential messages	Gaps	Useful tools available to fill gaps (scores > 13)	Comments
		component of good grazing management.			
BeefCheque / LambCheque Year 1. estimation of pasture biomass, pasture cover and soil fertility.	4, 6, 13, 38, 46, 53, 56	Monitoring the on-farm natural resource base can provide important information to make informed decisions as well as providing a mechanism for evaluating the impact of these decisions. Key factors which can limit the productivity of pastures include soil fertility, drought, weeds, salinity, acidity, low levels of on-farm biodiversity Monitoring key limiting factors of pasture growth e.g. pasture composition is an essential component of good grazing management.	 Methods for assessment of factors which influence productivity i.e. pasture biomass, pasture composition, groundcover, soil quality. Methods for assessment of factors which can impact on productivity (threats) e.g. salinity, erosion 	5, 12, 14, 15, 34, 43, 44, 45, 57, 58	No monitoring tools are identified within the workshop notes. A monitoring tool box could be developed to accompany participant notes. Tools could be sorted according to those which link to productivity as well as those which link to threat reduction

Page 29 Hyder Consulting Pty Ltd ABN 76 104 485 289

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5 Conclusions and Recommendations

The overall conclusions from the national review of on-farm monitoring tools are presented below. The recommendations on specific MLA programs and materials are presented in Section 4 of this report.

5.1 Conclusions

- 1 There is a plethora of natural resource monitoring information and tools available. It is difficult to identify those that will assist producers decide if they want to monitor and how will they use the information.
- 2 The national review of on-farm monitoring tools identified a total of 64 tools which were compatible with the project scope. There are 28 tools that can be recommended to the MLA for f usefulness (based upon 5 criteria including, practicality, resources, spatial relevance, accuracy and readiness for use) for on-farm application and ability to complement existing MLA programs and materials.

5.2 Recommendations

- 1 Organisations such as MLA need to present an integrated approach to sustainable production for producers. The integration of NRM tools within existing MLA programs is a positive way of achieving this integration. It may be valuable for the MLA to make the message clear as to why they think NRM monitoring tools are important for producers.
- 2 Monitoring of the on-farm natural resource base can provide crucial management information which can assist in preserving and maintaining long term productivity and asset values. This message should be communicated in all relevant MLA programs and materials.
- 3 Monitoring on-farm natural resource condition is a key ingredient of responsible environmental management and can be a useful factor in distinguishing producers from competitors within the market place. It may assist producers create possible alternative marketing options for their product. MLA should develop a set of case studies of where markets have rewarded producers with established NRM monitoring programs.
- 4 Some MLA programs and materials are currently limited spatially to specific regions. It is important to broaden the spatial scope for programs to ensure that as many producers as possible are provided with the opportunity to improve their management practices.
- 5 A supporting NRM monitoring tool box should be developed to accompany MLA programs and materials. Tools should be categorised according to those that link to productivity as well as those which link to threat reduction and cross-referenced to the appropriate programs and materials. This tool box should also include

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Page 30



simple step wise approaches for undertaking monitoring of key components of the natural resource base which are closely integrated with land management requirements e.g. a range of useful tools are available for monitoring pasture composition. This approach would provide producers with the ability to select tools which most closely support their management requirements. The MLA 'tips and tools' program may provide a useful platform for fulfilling this recommendation.

- 6 To date NRM monitoring tools have been developed largely at government agency and producer organisation level. It is recommended that producer focus groups are developed for different spatial areas within MLA regions to determine the usefulness of tools at producer level.
- 7 The NRM on-farm monitoring tools database could be modified to include only those tools which are likely to be most useful to producers (i.e. score >13) and made available to producers on the MLA's web site.



6 References

References in the form of web links for all tools identified in the national review of on-farm NRM monitoring tools are included within the monitoring tool database.

Anna Ridley (2004). 'AVC Resource Monitoring Tools (On-Farm) Workshop'. Report to Department of Agriculture Fisheries and Forestry from a workshop held on 27 July 2004.

MLA programs and materials

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Meat and Livestock Australia (2005), *Wean More Lambs.* Meat and Livestock Australia Limited, North Sydney, NSW

Meat and Livestock Australia (2005), *The Breeding EDGE – Workshop Notes.* Meat and Livestock Australia Limited, North Sydney, NSW

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Meat and Livestock Australia (2005), *Grazing Land Management – Central Australia Version, Workshop Notes.* Meat and Livestock Australia Limited, North Sydney, NSW





Organisation Contact List

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers

Page 33 Hyder Consulting Pty Ltd ABN 76 104 485 289

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Contact	Organisation	Action	Comments
Michelle	Vic DPI (Native	Left Message	No Reply
Butler	Vegetation)	Awaiting Reply	No hopiy
Richard McKewan	Vic DPI (Soils)	Left Message Awaiting Reply	No Reply
Louise Gilfedder	Tas DPIW	Left Message Awaiting Reply Left Message	Received Response from John Harkin at Tas DPI and sent email for him to circulate around the department
John Warren	Agriculture WA	Awaiting Reply Reply Received	Guided to a self assessment too on sustainability which did not include any on farm monitoring.
Neal Dagliesh	CSIRO	Left Message Awaiting Reply	No Reply
Chris Murphy	CSIRO	Left Message Awaiting Reply	No Reply
Tim Clancy	Australian Government Bureau of Rural Sciences	Left Message Awaiting Reply, Reply Received	Guided to VAST, Biodiversity Benefits Index
Greg Hocking	Tas DPIW (Wildlife)	Left Message Awaiting Reply	Received Response from John Harkin at Tas DPI and sent email for him to circulate around the department
Richard Thackway	Aus Gov Bureau of Rural Sciences	Left Message Awaiting Reply, Reply Received	Guided to VAST, Biodiversity Benefits Index
John Harkin	Tas DPIW (Veg)	Left Message Awaiting Reply, Reply Received	Received Response from John Harkin at Tas DPI and sent email for him to circulate around the department. (john.harkin@dpiw.tas.gov.au)
Micheal Askey-Doran	Tas DPIW (Rivers/Soils)	Left Message Awaiting Reply, Reply Received	Sent him an email with the feedback form and he will circulate it around the DPI Tas
Niel Lantzke	Agriculture WA (Water Salinity)	Left Message Awaiting Reply	No Reply
Graham Swan	QId DNRM	Left Message Awaiting Reply	No Reply
Fiona Simpson	TOPCROP	Left Message Awaiting Reply	No Reply
Peter Carberry	CSIRO	Spoke with him on the phone	Gave him email details, he will send me any further information that he may find
Rowan Prince	Agriculture WA	Spoke with him on the phone	Directed me to Brian McIntyre 08 9368 3736 & John Noonan 08 9368 3123 who directed me to John Warren
Scott MacDonald	DPI Vic	Spoke with him on the phone	Directed me to Target 10 Website
Andrew Straker	DPI Vic	Spoke with him on the phone	Directed me to Anna Ridley (Contacted by Brad Searle)
Anna Ridley	DSE Vic	Brad Searle on the phone	Sent Materials on all tools she has
Librarian	Kondinin	Spoke on the phone to Elisia	No available material
Phill Franklin	DPI Vic	him on the phone	Directed to Troy Clarkson
Troy Clarkson	DPI Vic	Spoke with him on the phone	Noted prograze, lambcheck and beefcheck
Dr Bill Bowden	Agriculture WA.	Email Contact	Primarily involved in monitoring tools
Chris Gazey	Agriculture WA	Spoke with him on the phone	Taken over from Amanda Miller for soils monitoring, will send me a hardcopy of any tools he may find.
Abigail Jenkins	DPI NSW	Spoke with her on the phone	Will send me a hard copy of any tools that she may find.

Page 34

National Review of On-Farm Natural Resource Monitoring Tools for Red-Meat Producers



Contact	Organisation	Action		Comments	
David Tongway	CSIRO	Left Message Awaiting Reply	No Reply		