

ACLUMP

Status of Land Management Practices:  
Activities of the Australian Collaborative  
Land Use and Management Program

# Status report

Australian Collaborative Land Use and  
Management Program



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# ACLUMP

## Status of Land Management Practices: Activities of the Australian Collaborative Land Use and Management Program

### Australian Collaborative Land Use and Management Program



Australian Government  
Australian Bureau of Agricultural and  
Resource Economics and Sciences



Australian Government  
Geoscience Australia



Environment,  
Climate Change  
& Water



Government  
of South Australia



Tasmania  
Explore the possibilities



Department of  
Primary Industries



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Agriculture and Food



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## Executive summary

Through the Australian Collaborative Land Use and Management Program (ACLUMP), partner State and Australian Government agencies have cooperated to provide consistent land use mapping for the whole continent. Land use mapping classifies the purpose for which land is used.

The next important step in this collaborative program is to supplement land use mapping with equally consistent information on land management practices.

Land management practices describe the way that land is managed. They indicate the 'how' of land use. They are the means by which improvements in natural resource condition can be achieved.

Spatial and temporal information on land management practices is needed for:

- targeting action to improve productivity, resilience to drought and climate variability, and water management
- identifying where investments in better management practices could improve the quality of ecosystem services delivered by agricultural land users
- risk assessment and evaluating the performance of agricultural industries
- modelling landscape processes that affect the natural resource base and generate problems such as salinity, water quality decline and soil loss.

Land management practices information is also needed for reporting on the effectiveness of programs for natural resource management, water, climate change, productive and sustainable agriculture and biosecurity. Program logic for these programs emphasises the importance of identifying intermediate outcomes and associates these outcomes with increased adoption of improved management practices.

ACLUMP's partner agencies are working together to develop a Land Use and Management Information System (LUMIS) to support the need for information on management practices that will enable timely and consistent reporting of intermediate outcomes, and provide early insights into progress towards longer-term resource condition outcomes.

The strategic aim for LUMIS is to develop a system that can be used widely by governments, industry, regional and other stakeholders and that, being firmly based on standards, is able to provide consistent information products and services to support monitoring, evaluation, reporting and improvement requirements of national programs.

For ACLUMP to deliver consistent land use mapping for Australia, support was obtained from key national, state and territory governments. Similar support is now needed for development of LUMIS and its data collation activities to ensure that it addresses national priorities for information relevant to biosecurity, water, climate change, and natural resource management policies and programs. Effort needs to concentrate on providing data where change to farming practices is most urgent and will give the best return on investment.

As there is a large range of land management practices, it is important to focus on a suite of practices that are used across a range of industries, have a significant influence on the condition of soil, land, water, the atmosphere and some aspects of biodiversity and are linked to the long term sustainability of production.

In the context of the *Caring for our Country* initiative – and especially its sustainable farm practices priority area – this document points to the high importance of recording information on ground cover management. Ground cover provides the protective layer of living and decaying plant material on the soil surface. Management practices that improve ground cover help reduce the risk of wind and water erosion, improve the storage of soil carbon, which helps increase the productive capacity of soils, and increase the capacity of the land to recover from drought. Programs that achieve adoption of practices that maintain or improve ground cover can be expected to provide a high return on investments.

Improved land management practices are also likely to be a significant part of a framework for sustainable agriculture.



# PART 1: Development of LUMIS

## Introduction

The mechanism for developing a collaborative program to record and map land management practices is a Land Use and Management Information System (LUMIS).

Major national programs have attracted some criticism for their inability to effectively establish that natural resource investments have achieved their expected outcomes. For example, the Australian National Audit Office pointed to failure by national natural resource management (NRM) programs to establish results in terms of expected improvements in resource condition.

*National programs have failed to prove achievement of their expected outcomes*

Planning for the current round of major national natural resource investment programs has concentrated on the use of 'program logic' to develop a strategic approach to address problems of this nature. Recognising that resource condition outcomes are not easy to measure and that it may not be possible to demonstrate improvements within the normal 'lifespan' of projects, the program logic approach identifies 'intermediate' outcomes – measures of performance that point towards the achievement of longer-term outcomes.

A focus on land management practices (LMP) can yield timely information that is applicable to intermediate outcomes. Land management practices describe the way that land is managed. They are the means by which NRM outcomes are achieved. Monitoring and mapping of actual land management practices will be an efficient and cost-effective way to provide information required for evaluation and reporting on progress towards targets for resource condition outcomes.

*Information about management meets needs to establish progress towards long-term outcomes*

There are two aspects to information about land management practices that can reveal intermediate outcomes. The first – of concern to LUMIS – is information about actual on-ground action by resource managers. The second, information about capacity and willingness of managers to make changes in how they manage, is highly relevant but outside the purview of LUMIS.

## Stakeholders in a land management information system

To embrace responsible land management requires an understanding of where change is needed, what alternative practices are available, whether there are impediments to desirable changes, and how to achieve change in the most efficient and effective ways. The demand for information on land management practices comes from:

- governments that seek to be well informed investors in changes that improve natural resource management outcomes
- industry groups that seek both improved productivity and competitive advantage for their members from changes in management practices
- individual managers, community groups and local or regional authorities that seek specific economic, social and environmental outcomes
- scientists and others who seek understanding of the on-site, proximal and/or off-site impacts of different practices in order to develop better alternatives.

This breadth of demand is reflected in the wide range of needs for land management practice information to support national priorities. These needs encompass:

- agricultural productivity and sustainability – profitable production of food and fibre, adoption of sustainable agricultural practices
- market access – environmental credentials, industry best management practices (or beneficial management practices – farming methods which minimise risk to the environment without sacrificing economic productivity)
- biosecurity – managing invasive species and minimising the impact of incursions, managing weeds and feral animals and their impact on threatened species
- environmental protection – managing and mitigating the impact of production systems on terrestrial, aquatic, coastal and marine habitats
- climate change – managing soil, vegetation and livestock to reduce emissions and/or sequester carbon; adjusting to and mitigating climate change impacts
- water availability and quality – responding to water allocation and efficiency needs; responding to water deficits arising from the drought and the need for increased environmental flows; managing water quality, including sediment and nutrient loads
- soil productivity – maintaining productive soils, managing wind and water erosion, soil carbon and acidification
- natural resource management – setting soundly based targets and monitoring procedures for natural resource investment at national, state, regional and local levels of responsibility.

.....  
*National needs for information come from water, climate change, biosecurity, NRM and agricultural production policies and programs*  
 .....

A broad suite of programs and projects that address issues of resource condition will need information on land management practices to meet the requirements for monitoring, evaluation and reporting. At the national level, information needs for all areas must be considered because there

are important overlaps for issues such as climate and soil carbon, biosecurity and invasive species management, water availability and water quality, sustainable agriculture and agricultural productivity, drought preparedness and landcare.

***Other drivers and their information needs***

The present and future information needs of national policies and programs are extended by complementary, often overlapping policies and priorities of state and territory governments and by industry, regional authorities and local governments.

.....  
*Information needs of national government are matched by the needs of other levels of government and by rural industries*  
 .....

Part 2 of this paper provides supplementary information on drivers of land management practice information and national policy and program initiatives that have particular information needs to meet requirements for accreditation or reporting.

**Benefits from the development of LUMIS**

***Supporting monitoring and evaluation of government programs***

A fundamental objective of major government investment programs under the banner of sustainable land use is to prevent, or reverse, the decline in condition of Australia's natural resources – our soil, water and vegetation assets. Land managers and decision-makers have different levels of concern with different outcomes – economic, social or environmental – and they therefore have a range of reasons for interest in improvements to the value and availability of information. In general, their questions hinge on where, when, why and how a change in land management practices would have an effect on outcomes.

.....  
*The LUMIS development will provide support for national program evaluations*  
 .....

Ongoing development of LUMIS, especially completion of its procedures for analysis and delivery of data, needs to proceed so that it can:

1. provide 'baseline' maps of the distribution of key management practice categories as an input to decision-making for investment where the aim of the investment is behavioural change or increasing adoption of sustainable practices
2. provide data to support improved understanding (including predictive modelling) of our impacts on water, soils, plant and animal resources
3. provide information to support the identification of intermediate outcome targets
4. collate temporal and spatial information to improve reporting on management practices and the performance of particular components of wider programs
5. provide fundamental data on results of investment in terms of spatial and temporal change in management practices and specific actions as required by monitoring and evaluation strategies.

Implementation of the Monitoring, Evaluation, Reporting and Improvement (MERI) framework of the Caring for our Country initiative requires monitoring to determine how successfully program investments are driving change and achieving targets for the use of management practices that are known to have beneficial long-term resource condition outcomes.

## Land management practice information priorities

### *Identified priorities of governments and industries*

There are, potentially, hundreds of different management actions that may be used to meet land use objectives. Information about these actions is needed for tracking progress towards objectives and for reporting program performance. While a variety of information on land management practices is assembled by government agencies, research institutions, community groups and industry, the value of the individual collections is limited and less than cost effective if not broadly applicable across a range of needs. This makes it essential to develop a consistent system for compilation of data able to meet a wide range of information needs.

.....  
*Many information needs are common to a broad range of national priorities*  
 .....

Common priorities have been identified from an analysis of the inherent value of land management practices to policy and programs that reflect a broad range of national needs. This analysis is derived from:

- industry based assessments including *Signposts for Australian Agriculture* industry profiles. These six industry profiles prepared by ABARES were designed to determine 'How does an agricultural industry contribute to ecologically sustainable development?'
- assessments conducted by ACLUMP partners in the states and territories initially including native vegetation protection measures, soil conservation methods, irrigation scheduling, and application methods, weed and pest animal control methods and crop rotation systems
- interpretation of this and other relevant information in the context of national needs.

The results suggest that there are practices that:

- are applicable across a range of agricultural industries
- significantly influence natural resource condition outcomes
- are linked to production and conservation objectives
- support long-term sustainability of production, and
- clearly relate to national needs.

Based on the analysis (see Tables 2A to 2C in Part 2 for details) data collection should focus on building an information base to record those practices that provide the most widely useful information for priority assets.

The major assets and priority of practices for consideration in productive landscapes are:

- soil – site preparation, modification and/or rehabilitation, maintenance and or amelioration of soil condition, and monitoring of physical, chemical and biological characteristics
- animals – breeding, promoting growth, controlling and preventing pests and diseases, animal product and waste removal, and monitoring



- plants/vegetation – establishment of plants and vegetation, promoting plant growth, controlling pests and diseases, hazard reduction, handling residues, removal of weeds and monitoring of infestations, and monitoring condition
- water – drainage, impoundment and extraction, reticulation, application/irrigation method, treatment, and monitoring

For some priorities, information needs may be satisfied by recording of industry recommended practices. For intensive land uses, information will mainly focus on water use and efficiency measures. However, for more extensive agricultural land uses – primarily dryland cropping and grazing of natural and improved pastures – the analysis suggests that the most widely useful information will be obtained from a focus on farming practices that most affect soils and the type and amount of their vegetative cover, especially where there are attendant impacts on surface and groundwater resources.

***Recognising and addressing priorities for information relevant to ground cover***

Governments commonly invest in natural resource management in response to problems where a public interest is countered by the results of previous degrading practices or where there are impediments to the adoption of better and more sustainable practices. Very often, the key driver for intervention is the need to address problems attributable to land clearing, cultivation and overgrazing. All of these affect ground cover.

Ground cover is plant material (or lack thereof) covering the land surface. It is generally expressed in terms of biomass or proportion of bare ground and measured as the percentage of ground cover, including crops, stubble, pasture plants and their residues, leaf litter, bark and twigs.

.....  
*For many national programs, the main focus of attention will be on ground cover management*  
 .....

Ground cover is usually considered in the context of protection of the soil surface from erosion or other types of degradation. All ground cover plays a major role in limiting soil erosion, improving water penetration into soils and adding organic matter that improves moisture holding capacity and plant growth. Native ground cover has particular biodiversity and environmental value. Ground cover is currently embedded in legislative processes and existing programs and is therefore linked to key business drivers. It is managed as a part of agricultural systems.

By reducing ground cover, many common practices have degraded the quality of our soil assets and depleted the biodiversity assets that depend on native vegetation. This indicates a high priority for programs that will achieve change by replacing land management practices that remove or degrade ground cover with practices that maintain or improve it.

Given this, LUMIS may need to pay particular attention to practices that, by their impact on ground cover, have strong and pervasive effects on the condition of soil, vegetation and water assets and the ecosystem goods and services that they provide.

*LUMIS will make an important contribution to the identification and recording of these management practices.*

***Other strategic priorities to extend the benefits of LUMIS***

The benefits that LUMIS can deliver to its stakeholders will greatly increase if, in determining its priorities for collection and provision of information, attention is given to:

- a strategic focus on information needs for hotspots for land use change, biodiversity conservation, water supply, etc
- identification of other priority areas based on capacity to profile land management issues on regional and industry bases
- development of capacity to distinguish normal patterns of farming activity (e.g. rotations) and indicators relevant to resource condition (e.g. seasonal changes in vegetative cover) from new and long term changes and trends
- ability to integrate information on the positive and negative impacts of management practices on natural resource outcomes and ecosystem services

- clarification of requirements for content and accuracy – for example
  - how much detail is required on land management practices, and
  - when does the data need to be spatially explicit
- ability to obtain consistent data over time (available at a range of scales and/or scaleable) to enable trends and changes in land management practice to be interpreted together with social and economic data
- clear guidance on how frequently data need to be collected for different land management practices
- advice on differences in the frequency of collection required for different purposes such as modelling, monitoring and reporting.

## Providers of land use and management information

Through their coordinated working arrangements for information on land use, partner agencies in the Australian Collaborative Land Use and Management Program (ACLUMP) have cooperated to provide land use mapping for the whole continent at national and catchment scales. Land use mapping classifies the purpose for which land is used.

### *ACLUMP has proven it is able to meet information needs*

ACLUMP's work has provided consistency based on agreed procedures covering coding and attribution, data structure, spatial referencing and accuracy. The next important step for this highly successful collaborative program is to supplement land use mapping with equally consistent information on land management practices.

The challenge is to develop an information system that can be used widely by governments, industry, regional and other stakeholders. The system must be able to provide timely and consistent information that will enable the reporting of intermediate outcomes, and provide early insights into progress towards longer-term resource condition outcomes.

As with land use mapping, LUMIS must be firmly based on standards if it is to be able to deliver consistent information products and services. Partners in the system must further develop the governance and technical arrangements

for classification, acquisition, mapping, and management of spatial and temporal information on land management practices that will effectively support the monitoring, evaluation, reporting and improvement requirements of national and other programs.

The strategic imperative is to secure the support of stakeholders for the ongoing development of LUMIS. The Australian program for land use mapping was developed with support from national, state and territory governments. Similar support is now needed for development of LUMIS and to ensure that its information collation activities address current national priorities.

### *The strategic aim is to gain stakeholder support for ongoing LUMIS development*

Earlier reference was made to sources of information about land management, including the complementary collection of information on capacity and willingness to change. The Australian Bureau of Statistics (ABS) is a key provider of this information. The role of ABS is also important for data about on-ground practices and ABS is a member of the ACLUMP consortium for this reason. ABS census and land management surveys are a key source of information on what practices are being used (and sometimes why) but this information has limited capacity to meet the full requirements for spatial accuracy that will often be essential for LUMIS. Frameworks that significantly address this issue are now being tested – the end result will be improvement of LUMIS, but not its replacement.

The Australian Bureau of Agricultural and Resource Economics and Sciences collects economic data similar to the ABS and social information about managers and their attitudes and behaviour. Industry groups, notably some industry Research and Development Corporations, are also significant stakeholders in data collection. Research and Development Corporations, universities and consultants also make important contributions and they can be expected to both use and contribute to LUMIS.

## Progress in the development of LUMIS

ACLUMP partners have recognised the need to provide a consistent classification of land management practices equivalent to the Australian Land Use Mapping (ALUM) classification for land use mapping ([www.abares.gov.au/landuse](http://www.abares.gov.au/landuse)). Key priorities included:

- the system must provide a nationally agreed categorisation that is appropriate for the very large number of individual management practices that can be identified and that will allow them to be recorded, grouped and mapped
- the framework of the classification must be flexible and comprehensive yet not so complex as to discourage either the providers or the users of its information
- the classification must be able to accommodate change in the type and distribution of individual practices
- the approach needs to recognise different requirements for LMP data.

ACLUMP has developed and is now testing a hierarchical categorisation of land management practices. In brief, it is a framework based on the principle that management practice information can be represented at five broad levels according to its primary aim.

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### *Testing a five-level classification of land management practices is the next major task for LUMIS development*

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The highest level recognises that soil, water, plants/vegetation, animals, air (or atmosphere), business and infrastructure assets are the primary target for a management action. The second and third levels relate to the generalised mode of activity and the general method used. The fourth level records recognisable categories of management practice and the fifth level records specific actions. Details on a specific action can also be recorded such as its frequency or the amount of inputs used or outputs produced. The schema is shown in Figure 1 with an example categorising the action of liming to maintain or improve soil condition.

High priority action for the further development of LUMIS needs to focus on testing the categorisation for its ability to consistently record information on practices that affect ground cover and present

this information in a standard set of products that meet the reporting requirements of MERI and other similar approaches.

To this end, the suitability of the LUMIS classification is being tested in a number of pilot projects. LUMIS partners are actively addressing issues such as methods for data collection, scales and frequency, database development and mapping and the interpretation of land management practice data. These projects will collate and map land management practices using:

- surveys of land managers
- information from local experts
- existing data from agencies, industry and local groups
- field mapping and interpretation of aerial photography or satellite imagery.

The pilot projects are expected to resolve a number of technical issues with a view to LUMIS having the capacity to provide information to, and collate information from, a wide range of natural resource programs. The focus of these pilot projects is summarised in Table 1.

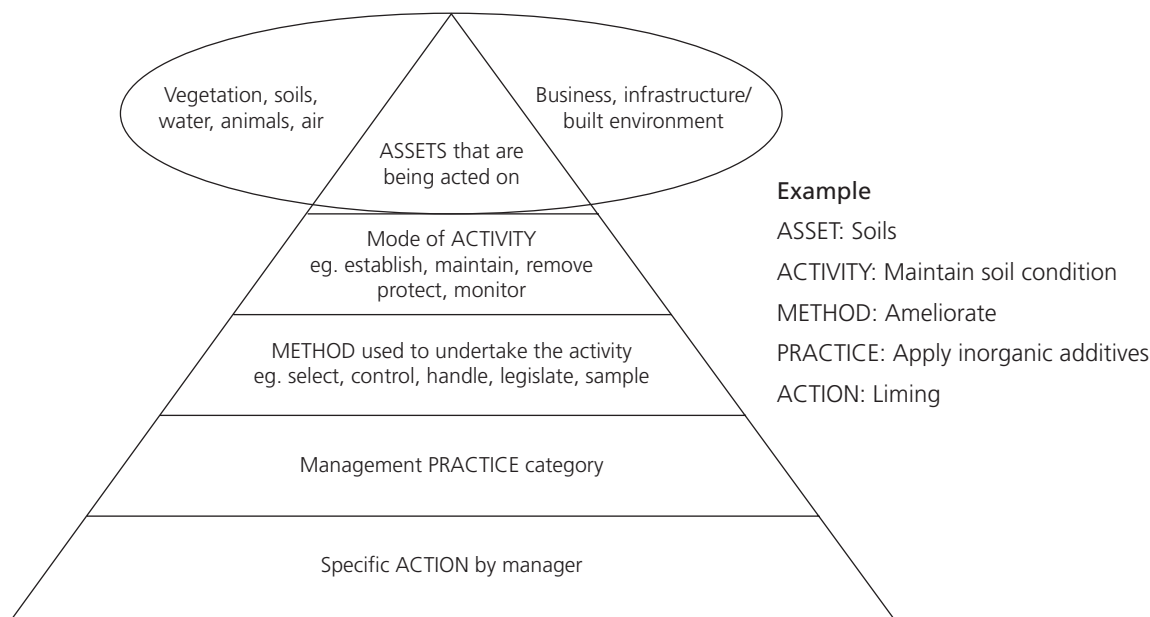
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*Capabilities tested include methods for data collection and mapping inclusive of scales, frequency, database design and data interpretation*

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Although LUMIS has been structured to allow inclusion of all land related management practices, the initial focus for development has been the agricultural sector. This sector manages in excess of 60 per cent of Australia's land area and also 70 per cent of the diverted water resource – making farmers and graziers the largest group of land managers in Australia. Further development of the LUMIS categorisation encompasses the management of forests, both for wood production and conservation.

Figure 1: The LUMIS categorisation system



## The way forward for LUMIS

### *Adopt and implement the existing LUMIS development*

Priority decisions and actions to implement the LUMIS framework and ensure that it continues to deliver products able to meet data and information needs of government, industry, research and other natural resource management interests include:

1. consolidating the experience gained from the six pilot projects and, following any revision indicated by these projects, release and promote the LUMIS classification to potential data providers
2. encouraging consistency within and across jurisdictions and ensuring capacity to include and integrate information being collected by other agencies and programs
3. maintaining a focus on relationships between land use, land cover and land management practices and how they interlink and may change over time.

### *Establish the niche and market for LUMIS*

There is potential for an unmanageable explosion in the amount of detail that might be demanded on land management practices. Development of the system has been undertaken with effective collaboration across state and territory and

national levels of government and with significant involvement of the Australian Bureau of Statistics. It has recognised the obverse component of information on farming practices – information about land managers such as their awareness, capacity and willingness to change and actual adoption of sustainable farming practices.

.....  
*Engagement with stakeholders is essential and a communication strategy is needed*  
 .....

To maintain LUMIS as a flexible, consistent and yet comprehensive system, partners in its further development will need to recognise that industry groups are strongly promoting the adoption of recommended practices and, for purposes such as accreditation, are actively and with some regularity compiling information on land management. Priority actions for LUMIS partners will be to:

1. set priorities for the data to collect and collate for LUMIS to meet national, state and regional needs
2. identify industry and other relevant data collections that contain information relevant to LUMIS

**Table 1: Summary of state pilot projects contributing to LUMIS**

Jurisdiction	Brief project description
<b>New South Wales</b> (Department of Environment, Climate Change and Water)	Trial DECCW's land management practices database in the upper Hunter region. Provide seamless dataset of LMP information collected showing linkages to LUMIS categories and giving associated land use.
<b>Northern Territory</b> (Department of Natural Resources, Environment and the Arts)	Aligning with best practice key areas, collect LMP directly from landholders and through utilising existing data sources for NT.
<b>Queensland</b> (Department of Environment and Resource Management)	Map contour banks in Queensland using high resolution imagery. Determine potential of these technologies for detecting and monitoring controlled traffic farming.
<b>South Australia</b> (Department of Environment and Natural Resources)	Analyse state and regional broadscale cropping management practices information using the time series of land manager surveys together with the annual land erosion transect results. Provide survey data attributed to LUMIS categories and associated land use.
<b>Tasmania</b> (Department of Primary Industries, Parks, Water and Environment)	Through desktop and field methodologies trial mapping of priority LMP (related to native vegetation, property planning, riparian areas and irrigation, cropping) in the South Esk area.
<b>Victoria</b> (Department of Primary Industries)	Within a region of the Goulburn Broken CMA map LMP relevant to biodiversity catchment outcomes. Provide LMP data linked to LUMIS and land use.
<b>Western Australia</b> (Department of Agriculture and Food)	Provide input to LUMIS and its categorisation, and will be learning from the pilot projects in other states.

3. promote the LUMIS framework to industry to
  - enhance consistency in terminology and
  - minimise duplication of effort
4. negotiate data sharing protocols and agreements where appropriate, and
5. develop, maintain and provide access to nationally consistent land management information products.

**Data collection**

A refined LUMIS classification and improved spatial frameworks for LMP surveys need to be supported by advances in mapping of on-ground management practices. Essential development of rapid, low cost and repeatable methods will require ongoing effort to test spatial technologies that have potential for mapping land management practices – especially those practices that affect on ground cover.

In this context, strategic development by the LUMIS participants needs to be undertaken in close collaboration with work on mapping land cover being undertaken elsewhere. Key recent or ongoing projects include:

- the National Carbon Accounting System's Land Cover Change program (Department of Climate Change and Energy Efficiency)
- the *Auscover* initiative under the Terrestrial Ecosystem Research Network (TERN)
- the National Vegetation Information System (NVIS) mapping and related work on the Vegetation Assets States and Transitions (VAST) framework and ecosystem services
- modelling and recording soil erosion and its relationships with ground cover
- State agency programs, in particular the Queensland Statewide Land Cover and Trees Study (SLATS)
- the Agricultural Land Cover Change (ALCC) project (1990–1995)
- related work by other data and information coordinating committees, especially the Australian Collaborative Rangelands Information System (ACRIS), the National Committee on Soils and Terrain (NCST); and the Australian Water Resources Information System (AWRIS).



.....  
*Collaboration with other interests in mapping of ground cover is important to LUMIS*  
.....

Recognition of linkages with other current work that has relationships to ground cover is important. Significant areas include studies and information services on dryland salinity and pasture condition.

***Local and regional scale monitoring and data aggregation***

Some further refinement of the LUMIS classification may be needed to support monitoring at local scales. The classification, and mapping methods, must also support aggregation to regional scales to provide context for assessment of broader and longer-term trends in resource condition outcomes. Other issues include:

- clarifying scale and level of detail for collection of information
- clarifying when data collection needs to be spatially explicit
- providing clear guidance on how frequently data need to be collected for different land management practices
- providing advice on differences in the frequency of collection required for different purposes such as modelling, monitoring and reporting
- ensuring consistency in time series given likely change in personnel.

***Collaboration with providers of economic and social information***

Further development of survey instruments is an area with high potential for improved information. Adoption of a flexible spatial sampling and reporting framework for the ABS and ABARE surveys needs to be strongly supported in the LUMIS development. Further progress in this area may allow consideration of:

- additional industries and smaller farms
- improved business management practices
- processes of adoption and agents of change
- protocols for detecting and reporting change
- additional attributes of specific management practices.

***Planning and governance of the LUMIS development***

The LUMIS development is advised by the National Committee for Land Use and Management Information (NCLUMI). Its membership includes Australian and State Government partners. Its work is sponsored by the Australian Government Department of Agriculture, Fisheries and Forestry with day-to-day management provided by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).

NCLUMI and its technical advisory group(s) need to ensure that LUMIS development maintains consistency with the Australian Land Use and Management (ALUM) classification.

ACLUMP partners are in the best position to promote general adoption of the LUMIS classification and to ensure that data collected at local and regional levels meets required standards and can be integrated for the monitoring and evaluation requirements of programs.

## PART 2: Further background to LUMIS

### The need for engagement of the ACLUMP partnership

Information on land management practices is assembled by government agencies, research institutions, community groups and industry. However, in the absence of an agreed approach for describing, organising and sharing the data, it is difficult to compile land management information in the way it is needed for tracking progress.

The specific purpose of the LUMIS initiative is to *provide mappable information on how Australia's natural resources – especially its soil, vegetation and water resources – are being managed and how management practices are changing over time*. LUMIS is linked to other initiatives that are designed to provide specific information about land managers, such as their capacity and motivations, and related information about rural industries and business management practices.

LUMIS will link land use and land management practices information spatially to provide a more complete picture of how the landscape is being managed and where and when changes are being made.

### Drivers for information

Key drivers for information on land management practices relate to:

- policy or program development
- planning in a range from national to local and property levels
- evidence for prioritising investments in key areas of vulnerability
- monitoring resource condition and trend
- monitoring, evaluation and reporting requirements of NRM programs
- informing actions that support integrated risk-management approaches to sustainable agriculture and maintain agricultural productivity and profitability
- industry accreditation and market access
- monitoring and enforcing legislation and regulations

- research and modelling activities
- reporting on land management practices (e.g. OECD – *Environmental performance of agriculture in OECD countries since 1990*).

### Stakeholders in LUMIS

#### Governments

Governments need information to support policy formulation, the design and targeting of programs and the delivery of programs, including incentives and regulations. They also need information on the uptake of management practices and their outcomes to support the evaluation and, if necessary, revision of policies and programs.

Broadly, governments require information that can support an improved understanding of the relationships between:

- land management practices and the achievement of economic, social and environmental outcomes
- the level of adoption of sustainable management practices
- the capacity of land managers to change management practices
- the impact of government initiatives on capacity to change
- the effect of these initiatives on adoption of alternative management practices.

Australian Government policy initiatives and joint initiatives of the Australian and state governments are being worked out in a range of programs that have bearing on the way that land is used – either by moving from production to conservation uses, or by regulating actions to change activities on the land, such as tree clearing, or by identifying and encouraging the adoption of improved management practices. Key government programs with increasing requirements for information on land management practices include *Caring for our Country*, *Australia's Farming Future*, the National Water Initiative and the National Forest Policy Statement. Other requirements arise from increasing attention to ecosystem services and national, state and territory reporting obligations.

Details of state and territory activities collated as background for this paper highlighted requirements for information to meet responsibilities for reporting on resource condition and trend and the performance of programs, especially at the regional level. Reporting requirements can be broadly identified as:

- legislated monitoring and reporting of natural resource condition and trends
- evaluation of the effectiveness of investments in NRM programs
- statutory requirements for reports on objectives for conservation, environmental condition and the management of land and water resources
- State of the Environment reporting.

### *Industry and land managers*

Australian agriculture is supported by a wide range of industry bodies, including the Research and Development Corporations (RDCs) and member associations. Industry RDCs are at least partly funded through producer levies. One of their roles is to assist industries in the uptake of management practices to enhance sustainable production. This is achieved through the development of codes of practices, best management guidelines and quality assurance schemes as well as by funding research into alternative management practices and technology.

Industry groups need information on water, soil and environmental management practices. For example, dairy industry needs include information relevant to:

- controlled application and efficient use of water
- maintenance of soil physical and chemical condition
- control of pests and diseases
- on-farm and runoff water quality
- air quality and other ecosystem services, including biodiversity.

Examples identified in early discussions with the Dairy RDC include practices used to

- deliver irrigation water (channel, pipe etc)
- measure the water holding capacity of soils
- measure the water needs of pastures
- intercept/re-use surface runoff and/or drainage
- manage tillage (methods, timing of cultivation, fallow etc)
- control access to water sources and bare areas
- ameliorate soils

- control pugging and compaction and impact on laneways
- balance nutrients, use feed refuse and manures and control pasture mix
- minimise risk of resistance by appropriate mix of chemicals and cultural and biological controls
- manage wastes and effluent
- protect waterways and wetlands
- provide for biodiversity, prevent loss of native vegetation, link remnants, revegetate with local provenance species, maintain breeding opportunities
- store and handle chemicals and dispose of containers.

At the enterprise level, high priorities that drive the need for land management practices information include improving productivity, targeting consumer preferences, capturing improved technology, reducing costs and improving profitability. Increasing capacity (know-how etc) also is important. Training activities provided by governments are designed to assist landholders consider and implement whole farm planning, which encompasses financial, production and environmental management.

The range and number of management practices that can provide useful information is large. Examples include property level actions for:

- removal and prevention of the spread of pest plant and animal species
- amelioration of soil acidity and water repellence
- contour banking of agricultural land susceptible to water erosion
- revegetation to enhance habitat and manage salinity
- conservation tillage practices to reduce risk of wind erosion
- rotational grassland grazing
- chemical fallow (rather than mechanical fallow).

Individual property managers increasingly need to respond to 'outside' interests when making decisions about what land management practices to use, where and when. Legislation operating at Commonwealth and State levels has important impacts on land management practices, including conservation regulations, land clearing controls, noxious weed eradication, agricultural chemical disposal, farm dam construction.

The emphasis on regional delivery of programs also can constrain or direct the activities of individual managers as they try to align their practices with regional objectives.

### **Research**

New and improved land management practices are developed either through innovation by land managers and/or as a result of research. Scientists need information to develop and test models. Models describe and formalise what is known of how a system works and the dependencies of elements of that system. They extend field experimental results and provide a tool for testing and improving our understanding of system behaviour. One of the most effective uses of modelling is for the identification of risks and the provision of decision support for their management. Information requirements are strongly related to the risk factors being addressed by a model. Major categories are:

- information relevant to yield and managing risks to production
- information relevant to product quality and managing risks to profitability
- information relevant to the resource base and managing risks to environment.

The land management practice data required will generally be met from studies or surveys that provide information about crop, tillage, stubble, pasture, stock, pest, weed and/or disease management and/or soil amendments.

### **Other stakeholders**

A highly important demand for LMP information comes from components of Australia's data and information infrastructure, in particular where this information is relevant to the data requirements for program monitoring and evaluation.

A draft report entitled 'The distribution of some major invasive plants in Australia in 2007', prepared for the NLWRA and the Australian Weeds Committee identifies the need for information in the following terms:

*Information on the extent of active management and, where possible, the type of management are both important in the development and evaluation of weed control programs. In particular, information products are required that provide:*

- *broad-scale (national and regional) baseline data and information on the extent of active management throughout Australia. These data will enable an overall assessment to be made of where control is being undertaken, and the costs of that control, particularly in the context of the abundance, distribution and potential spread of a species*
- *localised information to provide feedback on the most effective management action against a specific weed species, in the context of the particular environmental or economic asset being protected.*

Expert panels of the National Committee for Soil and Terrain (NCST) advised that 'information on land management is critical for interpreting the results of monitoring'.

With respect to individual indicators, the expert panels suggested:

- *information on land management practices is needed to estimate the net annual acidification rate which is affected by rates of product removal, additions of organic matter, fertiliser rates and ameliorative practices*
- *land management practices play an important role in organic carbon dynamics while noting that 'thorough investigation of how management practices and other environmental variables control soil organic carbon will only be possible at long-term research sites'*
- *land management practices are a surrogate for estimating likely soil loss*
- *trends in soil management practices are a valuable monitoring device*
- *one advantage of using management practices as an indicator ... is that it links directly with farmer attitude and practices.*

The NCST report's recommendations included support for NCLUMI investigations of methods for mapping land use and land management practices and development of a formal request for ACLUMP to collect land management information for soil condition monitoring.

These examples show that there is widespread need for information on land management practices. In many cases this has already translated into a significant level of support for the ACLUMP strategy for development of LUMIS as both a classification system and an integrated data and information resource.

## National priorities and their LMP information needs

### *Biosecurity*

AusBIOSEC is the Australian Biosecurity System for Primary Production and the Environment. It is a whole-of-government approach to biosecurity for primary production and the environment and has a major element of management action to deal with threats and established pest species. Its aim is to bring together, under an overarching national framework, biosecurity activities being undertaken by the Australian Government, state governments, industry, landholders and other key stakeholders in primary production and the environment.

AusBIOSEC has a wide scope that takes in everything from prevention and preparedness and emergency response to ongoing management of established species. It includes managing pests and diseases of the terrestrial, freshwater and marine environments. Objectives that have direct implications for information on management practices include:

- to improve the management of pests and diseases that have negative impacts on the environment or social amenity
- to achieve more efficient and timely responses to new incursions to reduce the overall impacts of pests and diseases.

### *Water*

Water availability and drought preparedness are increasingly important national priorities. The aims of national water strategies include more efficient, productive and profitable use of water. The National Water Initiative represents the Australian Government's and state and territory governments' shared commitment to water reform in recognition of the national imperative to increase the productivity and efficiency of Australia's water use; the need to service rural and urban communities; ensure the health of river and groundwater systems, including by establishing clear pathways to return

all systems to environmentally sustainable levels of extraction.

At a high level, implementation of the National Water Initiative includes some strategies that address management practices and point towards particular information needs. These are:

- statutory provision for environmental and other public benefit outcomes and improved environmental management practices
- water accounting that is able to meet the information needs of different water systems in respect to planning, monitoring, trading, environmental management and on-farm management
- policy settings that facilitate water use efficiency and innovation in urban and rural areas
- recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource.

### *Climate change*

Investigation of opportunities to link improved soil management and reductions in carbon emissions will require information on the current distribution of management practices that affect on soil carbon – whether positively or negatively. As part of the Australia's Farming Future initiative, the Australian Government is investigating how better soil management practices can form part of Australia's response to climate change.

Other issues related to climate and agricultural productivity, such as drought preparedness and soil erosion, require management practice information that is effectively linked with land use to provide key data on what is happening, what results can be expected and how better outcomes might be achieved.

### *Natural resource management*

#### *The Caring for our Country initiative*

The Caring for our Country initiative seeks 'an environment that is healthy, better protected, well managed, resilient and provides essential ecosystem services in a changing climate'. These services include protected biodiversity and natural icons, clean water and air, healthy soils, and sustainable food and fibre industries. The program seeks to achieve strategic objectives in six national priority areas, all of which will generate needs for information on land management.



The priority areas are:

- a national reserve system
- biodiversity and natural icons (including weeds, feral animals and threatened species)
- coastal environments and critical aquatic habitats
- sustainable farm practices
- natural resource management in remote and northern Australia
- community skills, knowledge and engagement.

The sustainable farm practices priority specifically recognises the central importance of information about how the nation's productive agricultural land is managed. Indicative funding priorities relevant to management practices include management of weeds and feral animals and improved soil management on farms.

## **Analysis of priority land management practices**

A preliminary ABARES review has identified land management practices from the LUMIS categorisation that relate to ground cover management. (Table 2A). The analysis shows how each practice can contribute to improvements in resource/asset condition.

Table 2a: Land management practices from the LUMIS categorisation that relate to ground cover management

		RESOURCE / ASSET CONDITION IMPROVEMENT						
		Soil				Plants & animals	Air	Water quality
Land Management Practice		Maintain soil carbon	Reduce soil erosion (wind)	Reduce soil erosion (water)	Maintain soil pH above critical levels	Improve quantity and quality of biodiversity	Reduce CO <sub>2</sub> emissions and aerosols to atmosphere	Improve water quality (TN, TP, EC, TSS, pH?)
Ground cover maintenance		✓	✓	✓		✓	✓	✓
Reduced tillage		✓	✓	✓		✓	✓	✓
Reduced fallow		✓	✓	✓		✓	✓	✓
Pasture phase in rotation		✓	✓	✓	✓	✓	✓	✓
Soil testing		✓			✓		✓	✓
- Nutrient management		✓					✓	✓
- pH management		✓			✓			?
- Salinity management			✓	✓			✓	✓
- Soil carbon		✓				?	✓	
Liming to maintain soil pH		✓	✓	✓	✓	✓	✓	?
Fencing/stock exclusion from riparian zones		✓	✓	✓		✓	✓	✓
Revegetation of riparian zones		✓	✓	✓		✓	✓	✓

Abbreviations: TN (Total Nitrogen), TP (Total Phosphorus), EC (Electrical Conductivity), TSS (Total Soluble Solids).

The LUMIS pilot projects have identified drivers and categories for land management practice information at the state/territory level (Table 2B). The analysis shows that each category can relate to multiple assets of the LUMIS categorisation. For example, good water quality can contribute towards improvements in crop yield (plants), stock drinking water (animals), soil nutrient availability (soils) and reduce the need for water purification systems (infrastructure).

Table 2b: Land management practice categories from the LUMIS state and territory pilot projects

Land Management Practice Categories	LUMIS ASSETS							
	Plants	Animals	Soil	Water	Air	Business	Infrastructure	
Crop tillage and rotation	✓	✓	✓	✓	✓		✓	
Native vegetation management	✓	✓	✓	✓	✓		✓	
Riparian zone management	✓	✓	✓	✓	✓		✓	
Benchmarking	✓	✓	✓	✓	✓			
Chemical management	✓	✓	✓	✓	✓			
Grazing management	✓	✓	✓	✓	✓			
Pest/disease management	✓	✓	✓	✓	✓			
Irrigation management	✓	✓	✓	✓	✓		✓	
Waste management	✓	✓	✓	✓			✓	
Water quality	✓	✓	✓	✓			✓	
Water supply	✓	✓	✓	✓			✓	
Salinity	✓	✓	✓	✓				
Soil testing	✓	✓	✓	✓				
Nutrient management	✓	✓	✓	✓				
Weed management	✓	✓	✓	✓				
Biodiversity	✓	✓						
Property planning						✓		
Market access						✓		
Research, training and development						✓		

The priority land management practices for six major agricultural industries are shown in Table 2C. These practices have been identified through the *Signposts for Australian Agriculture* initiative aimed at reporting agricultural industry contributions to sustainable development. The analysis identifies common priorities across industries. For example, fertilising with nitrogen and phosphorus are common across all six industries as this practice can contribute towards improvements in soil nutrient availability that leads to increased plant growth for crops (grains), pasture (beef and dairy), fruit (horticulture and wine) and fibre (cotton).

Table 2c: Land management practices identified from *Signposts* for six major agricultural industries

LUMIS Asset	Land Management Practice	AGRICULTURAL INDUSTRY					
		Grains	Beef	Dairy	Hort.	Wine	Cotton
Soil	Fertilising - nitrogen	✓	✓	✓	✓	✓	✓
Soil	Fertilising - phosphorus	✓	✓	✓	✓	✓	✓
Plants/Animals	Maintaining areas of conservation significance	✓	✓	✓	✓	✓	✓
Plants	Revegetating	✓	✓	✓	✓	✓	✓
Plants/Animals	Integrated pest and weed management		✓	✓	✓	✓	✓
Soil	Liming	✓	✓	✓	✓	✓	
Water	Regularly monitoring water quality	✓	✓		✓	✓	✓
Soil	Soil testing	✓	✓	✓	✓		✓
Soil	Conservation tillage	✓		✓	✓		✓
Water	Contour banks	✓	✓	✓	✓		
Water	Irrigation scheduling tools			✓	✓	✓	✓
Soil	Controlled traffic systems	✓		✓	✓		
Plants	Deep-rooted perennial pastures (legumes)	✓	✓	✓			
Water	Maintaining cover in waterways/drainage lines	✓	✓		✓		
Water	Managing riparian areas		✓	✓			✓
Water	Regularly monitoring water tables		✓	✓	✓		
Plants	Strip cropping	✓	✓		✓		
Soil	Applying gypsum			✓	✓		
Soil	Fertilising - potassium	✓			✓		
Water	Laser-levelling/grading of fields/paddocks			✓			✓
Plants/Soil	Maintaining soil cover				✓	✓	
Animals/Soil/Water	Managing effluent/wastewater			✓		✓	
Air	Managing spray drift					✓	✓
Plants	Monitoring pasture condition		✓	✓			
Infrastructure	Safely storing and handling chemicals					✓	✓
Water	Capping and piping artesian bores		✓				
Water	Piping stock water supplies		✓				
Water	Automating irrigation			✓			
Soil	Nutrient budgeting			✓			
Plants	Salt-tolerant pastures			✓			
Soil	Green manure cropping				✓		
Business	Applying RDI strategies					✓	
Water	Efficient irrigation methods					✓	
Plants	Re-using solid waste and by-products					✓	
Plants/Soils	Soil and plant tissue testing					✓	
Plants	Farm hygiene for pest/weed/disease control						✓
Plants	Managing resistance in transgenic cotton						✓
Plants	Yield mapping						✓

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