ACLUMP

Land Use and Land Management Information for Australia

Workplan

of the Australian Collaborative Land Use and Management Program

Land use has generally been considered a local environmental issue but it is becoming a force of global importance

(Foley et al 1995)

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The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), was formed following the merger of the Australian Bureau of Agricultural and Resource Economics (ABARE) and the Bureau of Rural Sciences (BRS) in 2010–11.

Executive summary

This workplan presents the case for a coordinated national land use and land management information program as part of national natural resources management and reporting capacity for Australia. It outlines a portfolio of activities over the next three years.

The workplan discusses how investment in national land use and land management information will support decision makers in the government and private sectors. It emphasises the needs of government as an investor to meet targets and achieve outcomes under the Caring for our Country program and related initiatives – particularly prioritisation, investment and performance reporting.

The workplan is supported by state and national agencies responsible for land use and land management practices information. It is part of an ongoing national effort by the State and Australian Government partners in the Australian Collaborative Land Use and Management Program (ACLUMP) – a program that promotes the development and use of nationally consistent land use and land management practices information.

The Australian Collaborative Land Use and Management Program is currently funded by the Department of Agriculture, Fisheries and Forestry and state agencies, with support from CSIRO, Geoscience Australia, and the Australian Bureau of Statistics. Partners requiring land management information are invited to collaborate, support and participate in the activities of the workplan.

The workplan focuses on seven activities:

1. **Communications and coordination** – promotion and dissemination of land use and land management information.
2. **National land use mapping** – for strategic planning.
3. **Catchment scale land use mapping** – for natural resources evaluation and management.
4. **Land use change assessment** – to enable the monitoring of change in natural resource condition and the effectiveness of public investment in natural resources, productivity and biosecurity.
5. **Land management practices mapping** – because of the strong relationship between sustainable land management practices, natural resources condition and productivity outcomes.
6. **Land cover** – to facilitate change detection and for better integrated land information products.
7. **Research and technical innovation** – critical to the capacity to generate relevant, cost effective and timely information products.

summary

Why is land use and management information important?

The Australian Government's policy goals for the economy, environment and society include improving competitiveness, sustainability, resilience, adaptability and profitability. These goals are shared with state and territory governments and industry.

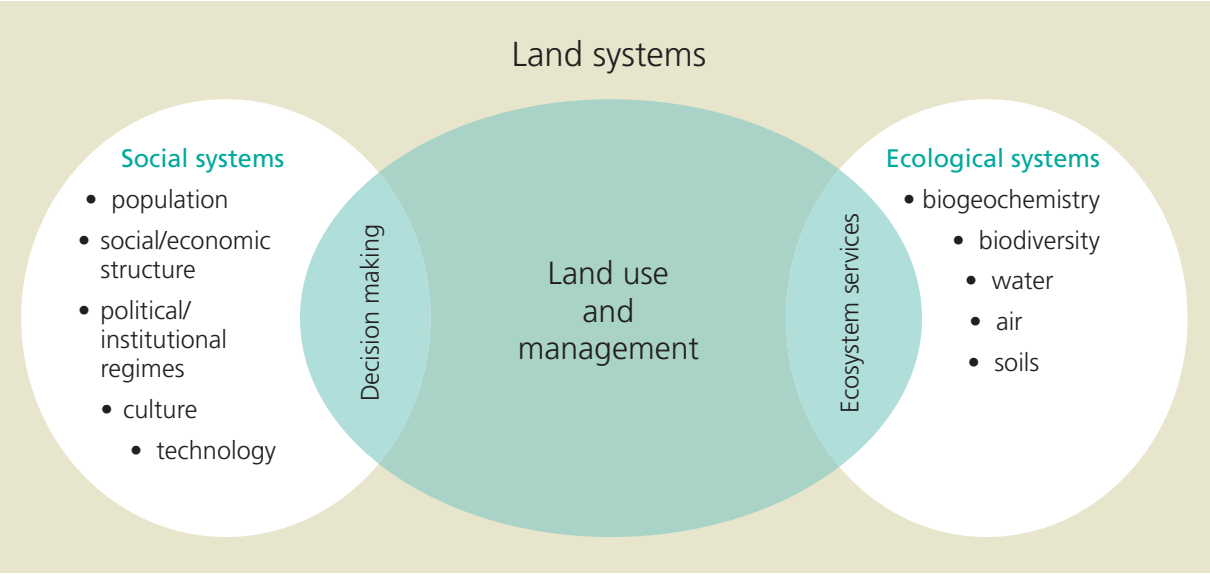
The way that land is used and managed has profound effects on Australia's social and ecological systems (Figure 1). There is a strong link between changes in land use and environmental, economic and social conditions. Land use and land management practices information can:

- support decision-making by governments, land managers and the agricultural sector
- be critical to developing effective responses to natural resource management priorities, including biodiversity protection, sustainable and productive agriculture, water quality and quantity, climate change adaptation, and food security.

Land use and land management practice information improves policy and program decision-making at several critical stages (Figure 2):

- **Prioritisation** – Describing what we use land for and how it is managed will improve the alignment of policy goals with environmental challenges.
- **Investment** – Information on the extent and effect of land uses and land management practices assists in determining which projects will most effectively deliver on the priorities.
- **Performance reporting** – Measuring changes in land use and land management practices that result from investments such as those under Caring for our Country to assess policy impact and progress towards goals.

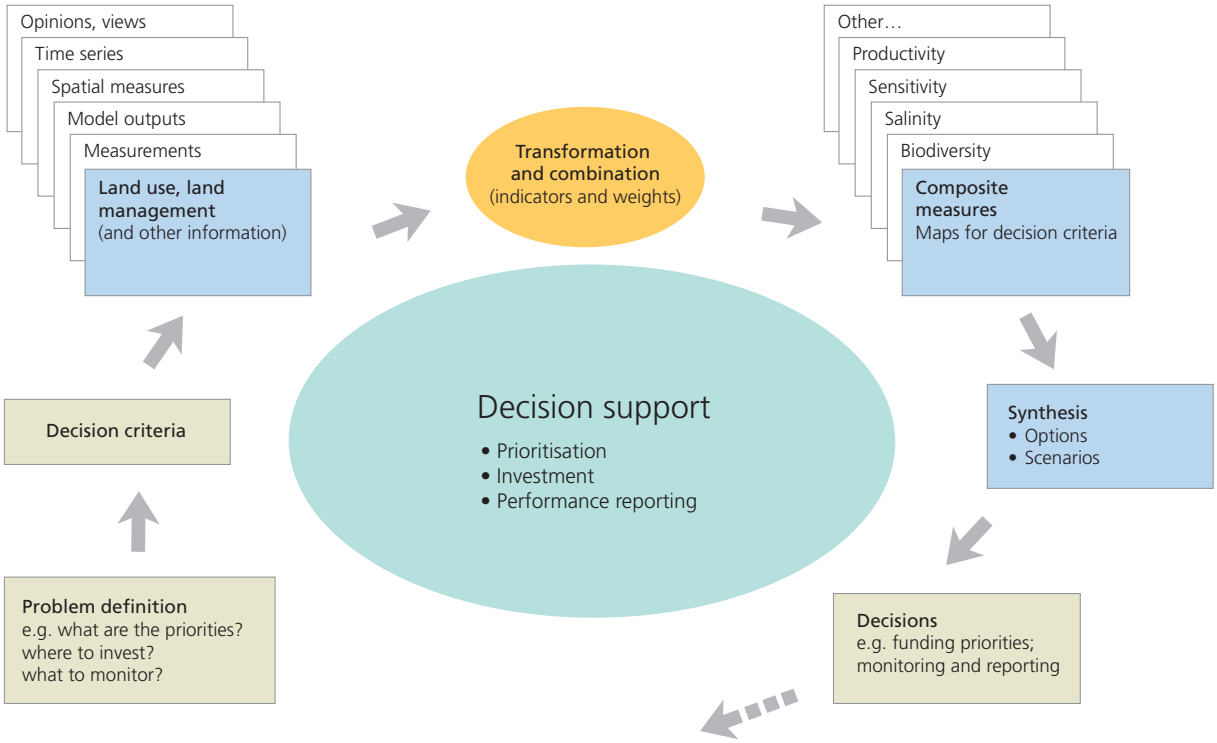
Figure 1: Key relationships in coupled human–environment systems



Adapted from: Global Land Program (2005)

Land use and management is the critical link between ecological systems, social systems and the sustainable use of natural resources. Effective natural resources management requires better understanding of the dynamics of land systems, the consequences of change and a capacity for integrated analysis and modelling.

Figure 2: The contribution of land use and management practices information to policy and program decision-making



Adapted from Lesslie et al. (2008)

Failure to maintain national capacity to monitor land use and land management practices in Australia will hinder our capacity to assess and respond effectively to Australia's natural resource management challenges, including the emerging issues of climate change, climate change adaptation and water management. It will limit our ability to identify where the best returns on investment can be gained. Without land use and land management information we will not be able to demonstrate progress towards sustainability.

How is land use and management information being used?

Land use and land management information has been used recently to:

- help create a business plan for investment under the Caring for our Country initiative
- plan water use allocations in high demand areas; ensure high value agricultural land is protected through regional planning; plan for Australia Plague locust control; and implement disease preparedness exercises in Western Australia (Western Australian Department of Agriculture and Food)
- help manage sediment and nutrient loads in the Gippsland Lakes (Victorian Department of Primary Industries)
- support regional natural resource planning and investment and strategies for industry development in South Australia (Department of Environment and Natural Resources)
- support pest and disease response planning for horticulture in the Northern Territory (Northern Territory Department of Natural Resources, Environment, The Arts and Sport)
- monitor, evaluate and report on vegetation and soil condition in New South Wales (NSW Department of Environment, Climate Change and Water).

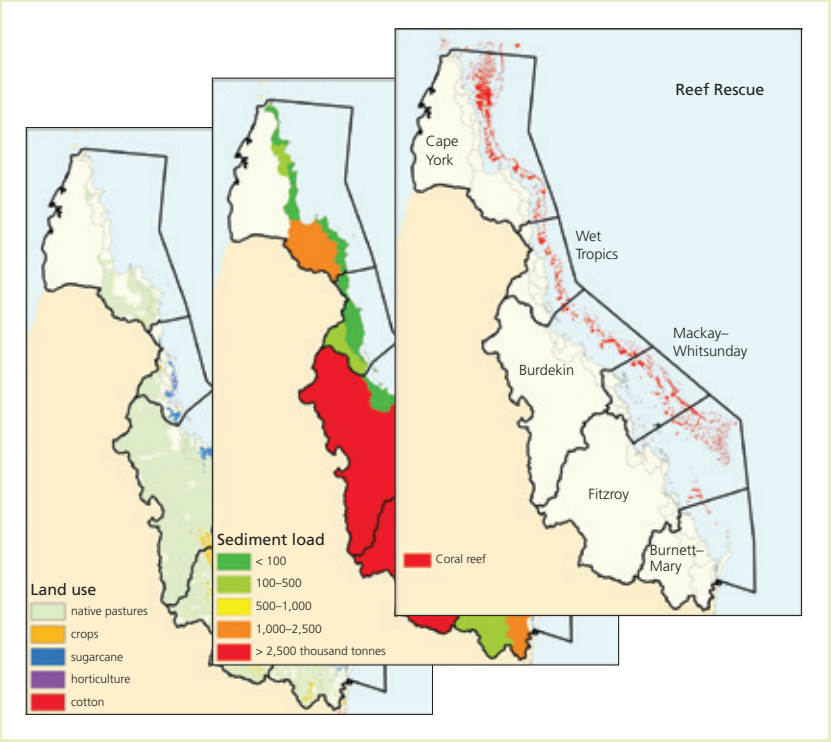
The Great Barrier Reef is one of the natural wonders of the world and an economic asset of major significance to Australia. Land-based pollution is a threat to the Reef and the Australian Government is addressing this as a national priority through the $200 million Reef Rescue program, part of the Caring for our Country – Reef Rescue initiative. The initiative aims to improve the water quality of the Great Barrier Reef lagoon by increasing the adoption of land management practices that reduce the run-off of nutrients, pesticides and sediments from agricultural land.

Land use information is making a critical contribution to effective targeting of this investment. The level of sediment, nutrient and pesticide run-off is determined largely by land use and management practices in the Reef catchment. For example, since European settlement, extensive rangelands grazing has greatly increased sediment loads and intensive coastal agriculture has greatly increased nutrient loads.

Image courtesy of GBRMPA

As part of ACLUMP, the Queensland Department of Environment and Resource Management has produced land use maps for reef catchments. Those maps are making critical contributions to:

- assessing the threat to reef assets from sediment, nutrient and pesticide outflows
- efficient targeting of the promotion of improved land management practices
- understanding social and economic capacity for land management practice change
- monitoring trends in resource condition and the effectiveness of investment
- monitoring land use change.



ACLUMP land use mapping for catchments adjacent to the Great Barrier Reef produced by the Queensland Department of Environment and Resource Management has been critical to modelling sediment, nutrient and pesticide risks to reef waters and to devising appropriate management responses, for example, targeting incentives for improved land management practices.

What is ACLUMP?

The Australian Collaborative Land Use and Management Program (ACLUMP) promotes the development of nationally consistent land use and land management practices information for Australia. ACLUMP is overseen by the National Committee on Land Use and Management Information (NCLUMI), a consortium of Australian and state government partners.

Established in 2000, ACLUMP has delivered catchment and national scale data and information to national, state and regional clients. ACLUMP products are in strong demand and there is widespread adoption of agreed standards.

The strategic aim for ACLUMP is to develop an integrated land use and land management practices information system for Australia to support national, state and regional initiatives dealing with national priorities such as food security, biosecurity, climate change and vegetation, sustainable agriculture and water and carbon management. This system, being firmly based on standards, will be able to provide consistent information products and services to support the monitoring, evaluation and reporting requirements of national programs, including national environmental accounting.

ACLUMP activities have been well supported by national, state and territory governments. However, expanded support is needed to ensure ACLUMP can deliver land use and land management practices information products that address emerging national priorities. Efforts need to concentrate on providing information where the demand is most urgent and will give the best return on investment.

ACLUMP is currently focused on fostering the development and use of nationally consistent land use and land management practices data sets. The program also supports development of land cover and ground cover data and information through partnership with the *Auscover* initiative.

Putting the national picture together

Before 1999, detailed land use mapping in Australia was limited and uncoordinated. Australian, state and territory government agencies independently produced land use mapping at a range of scales using a variety of cartographic methods and classification systems.

ACLUMP has developed nationally consistent land use mapping at 'catchment' and 'national' scales; established technical standards including a national land use classification system – the Australian Land Use and Management (ALUM) Classification; provided web-based delivery to facilitate community access to land use information; and reported on national and regional reporting of conditions and trends. The program is developing protocols for detecting and reporting land use change and the classification and spatial representation of key land management practices.

ACLUMP has delivered:

- **Mapping**: nationally consistent land use mapping for Australia at 'catchment' scales (multi-temporal mosaic layers) and 'national' scale (1992–93, 1993–94, 1996–97, 1998–99, 2000–01, 2001–02, 2005–06 at 1 kilometre resolution).
- **Coordination and standards**: agreed technical standards, including the Australian Land Use and Management Classification and the national Land Use Management Information System (LUMIS).
- **Communication and dissemination**: a national land use data directory (web and DVD-based) and the maintenance of land use datasets on Australian and state government data repositories.
- **Analysis and reporting**: regional and national analysis and reporting of land use and land management practices, including change reporting and integrated assessments.

Land use and land management describe the activities that are undertaken across the continent. These encompass the total spectrum of human modification of land through agriculture and urbanisation.

Key terms

There is often confusion about terms that describe aspects of human occupation, use and management of land. For example, 'land use' and 'land cover' may be applied in the same context, often together in established land use/land cover classification systems.

- **Land cover** refers to the observed physical surface of the earth, including various combinations of vegetation types, soils, exposed rocks, water bodies and human artefacts.
- **Land use** refers to the purpose to which the land cover is committed, including the production of goods (such as crops, timber and manufactures) and services (such as defence, recreation, biodiversity and natural resources protection). Some uses, such as cropping, have a distinctive land cover pattern, and are regular inclusions in land cover classifications. Others, such as nature conservation, are not readily identified from a characteristic land cover pattern. For example, where the land cover is forest, land use may be timber production or nature conservation. A single land cover class may support multiple uses and a single land use may involve several land cover conditions.
- **Land management practice** refers to the means by which a land use outcome is achieved – the 'how' of land use (e.g. cultivation practices such as minimum tillage or direct drilling). Some land management practices, such as stubble disposal practices, tillage and rotation systems, may be identified from characteristic land cover patterns and linked to particular land uses.
- **Ground cover** refers to plant material covering the land surface. It is generally expressed in terms of biomass or proportion of bare ground, measured as the percentage of plant material covering the ground and classified as bare, brown and green.
- **Commodity** usually refers to an agricultural, timber or mining product that can be processed. Commodity information may relate to land use and land cover.
- **Tenure** refers to the conditions under which land is held. Some forms of tenure, such as pastoral or mineral leases or nature conservation reserves, relate directly to land use and land management.

Details of the national status of land use and land management data and information produced through ACLUMP are included in a review completed by the National Land and Water Resources Audit (2008) **http://lwa.gov.au/products/pn20574**.

National land use information from 2005–06 is shown as a map (figure 3) and in tabular form (Table 1) on the following page. The locations and most recent date of catchment scale across Australia are shown in figure 4.

Figure 3: ACLUMP national land use map 2005–06

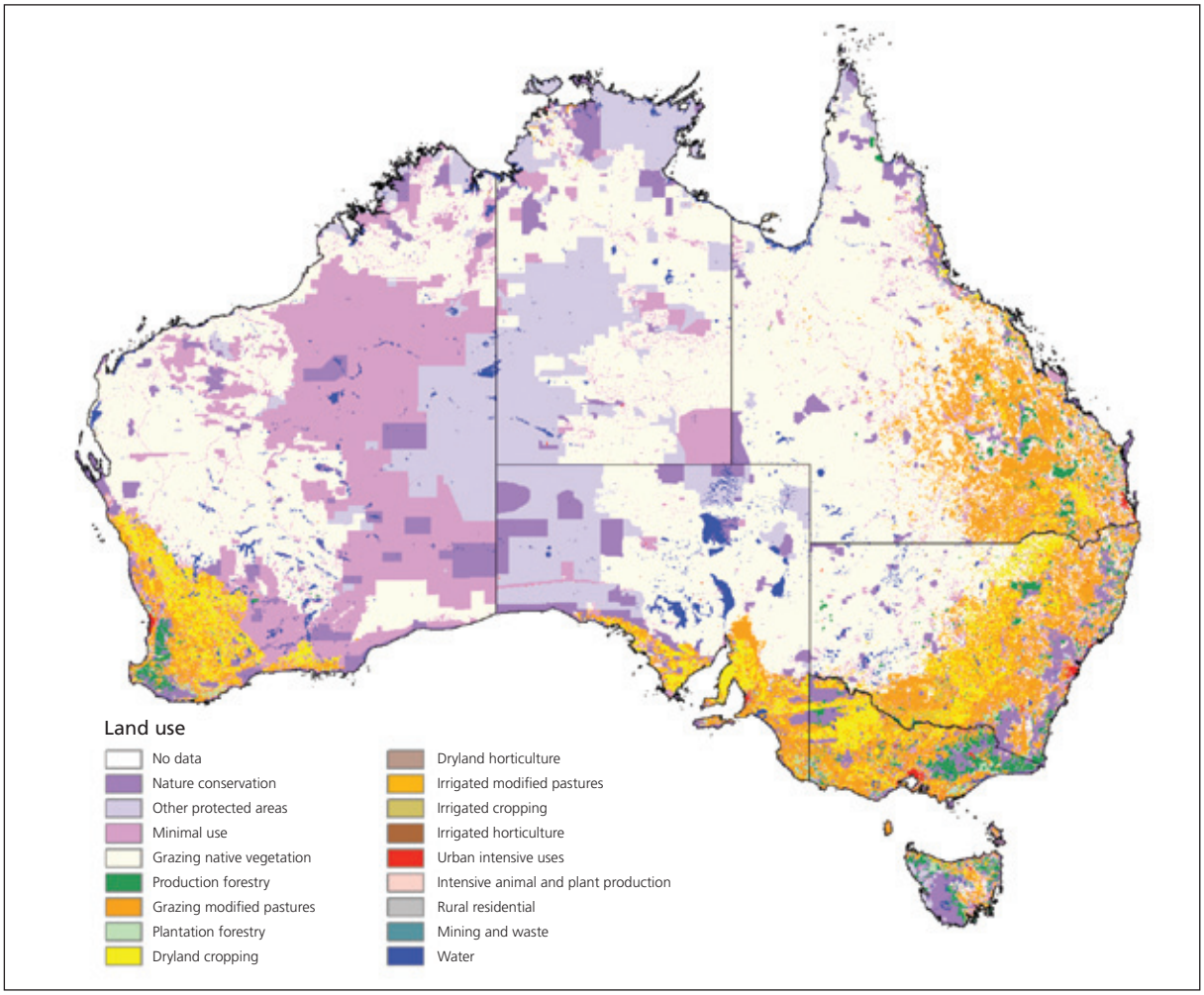
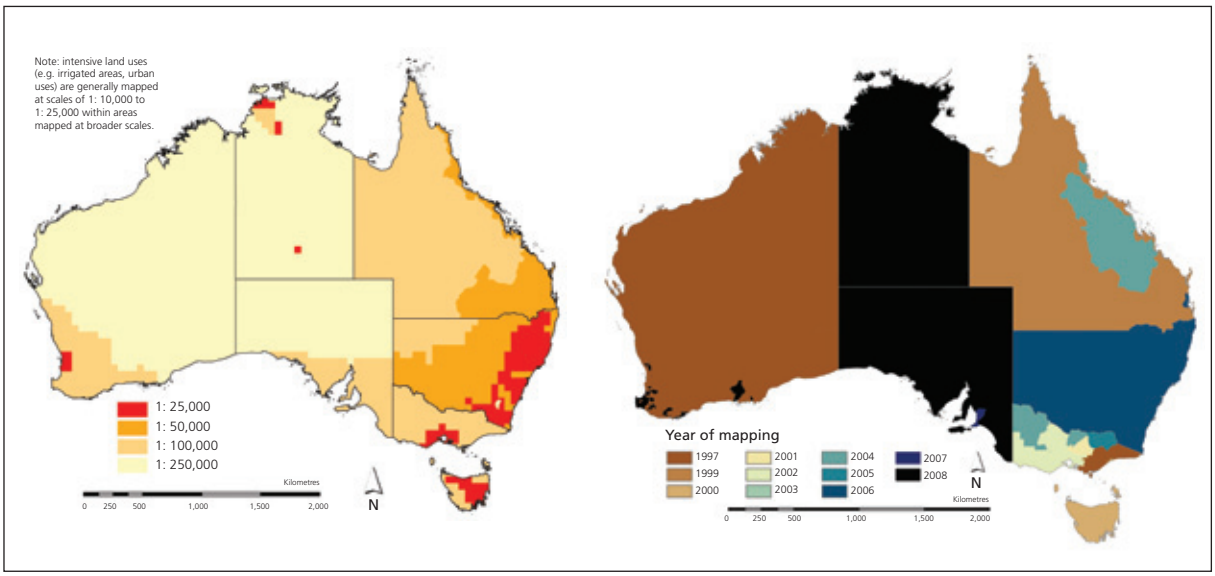


Table 1: ACLUMP National scale land uses 2005–06

Land use	Area (sq.km)	Percentage %
Nature conservation	571,483	7.43
Other protected areas including Indigenous uses	1,015,359	13.21
Minimal use	1,242,715	16.17
Grazing natural vegetation	3,558,785	46.30
Production forestry	114,314	1.49
Plantation forestry	23,929	0.31
Grazing modified pastures	720,182	9.37
Dryland cropping	255,524	3.32
Dryland horticulture	1,092	0.01
Irrigated pastures	10,011	0.13
Irrigated cropping	12,863	0.17
Irrigated horticulture	3,954	0.05
Intensive animal and plant production	3,329	0.04
Intensive uses (mainly urban)	16,822	0.22
Rural residential	9,491	0.12
Waste and mining	1,676	0.02
Water	125,618	1.63
Total	**7,687,147**	**100.00**

Figure 4: ACLUMP catchment scale mapping showing scale and year of mapping



The way forward: key activities

The aim for ACLUMP is to become firmly established as part of Australia's national natural resources information collation, coordination and accounting system.

The intention is to establish a system that routinely delivers nationally consistent land use and land management practices information that meets national priority needs. Linkage of the national and catchment data sets will also make information available to community groups at sub-catchment or property level. The system will be flexible and adaptive to accommodate changes in institutional arrangements, policy and program requirements, and new sources of information and delivery technologies.

As well as access to relevant data and information, informed, systematic and transparent analysis also requires integration. ACLUMP information is able to be combined and analysed using decision support tools in a way that helps stakeholders understand options and tradeoffs.

ACLUMP is primarily funded by the Department of Agriculture, Fisheries and Forestry, with major contributions from state and territory partners, the Australian Bureau of Agricultural and Resource Economics and Sciences, Australian Bureau of Statistics, Geoscience Australia, and other partners. Investment from other clients and stakeholders is also being sought.

Seven major activities form the basis of the ACLUMP work program.

1. Communications and coordination

A major focus of ACLUMP is promotion and dissemination of land use and land management information. ACLUMP coordinates and communicates data collation activities to support policy needs, and seek endorsement from a wider range of potential users of this information. This is achieved by:

- ongoing review of national, state, territory and industry land use and management information needs by technical working groups
- facilitation of partnerships between land use and management information providers and users through national workshops
- development of improved reporting capacity for land use and land management practices change
- improved cooperation at national, state, regional and industry levels and between government and private stakeholders
- dissemination of best available information through the ACLUMP website **www.abares.gov.au/landuse** and its associated on line mapping tools.

2. National land use mapping

National-scale land use mapping (approximately 1:2 500 000 scale) is required for strategic planning and continental modelling, such as national carbon accounting and salinity assessments at the river basin level. It is produced using modelling (called 'SPREAD') that combines agricultural commodity data from the Australian Bureau of Statistics (ABS) with satellite imagery, field information and other inputs. The relatively low cost of national mapping provides an opportunity to produce time series and probability mapping. ACLUMP has produced a national land use time series sequence dating back from 1993.

The most current national land use map available is the 2005–06 map which aligns to the 2006 census data.

An on-going task for ACLUMP is to align the production of national land use mapping with the Australian Bureau of Statistics' five-yearly census. The next major edition of the map would then be due for production in 2012. Areas for further development in this area include:

- refining procedures for linking land use mapping with information on land management practices
- building capacity to use this information to support national level decision-making, including forecasting
- ongoing work to improve verification and validation, for example by linking with catchment data sets, ground truth and signature reference sites
- an increasing focus on improving rule-based approaches for the identification of change in patterns of land use – requiring particular attention to quality assurance of mapping and data products, including metadata.

There are significant opportunities for wider applications of national land use mapping in dealing with national issues such as carbon accounting, biodiversity conservation and salinity assessment. Responses to these opportunities will necessarily be built on further advances in modelling, probability mapping and the development of national land use maps in time series (see section 7).

3. Catchment scale land use mapping

Developing effective solutions to natural resource management issues operating at the landscape level (such as salinity and soil erosion) requires land use information at catchment scale. Catchment mapping scales can range from 1:25 000 to 1: 250 000. The strong link between national natural resource management priorities and regional delivery requires a continuing focus on land use mapping at catchment scales, in particular the provision of:

- up-to-date and reliable catchment-scale land use information to natural resource management programs, including annual national update mapping comprising the most recent available inputs
- catchment-scale information on land use as it affects interception, overland flow, surface storages and accessions to groundwater
- reporting on resource condition by integration of catchment-scale land use information with information from other themes, especially water, soils and terrain, and vegetation
- linkage of land cover change detection, for example, the Statewide Land and Tree Survey in Queensland and New South Wales, with land use change.

State and territory partners have the primary role in catchment-scale mapping and data management. Their priorities for ongoing work can differ. Program development requires ongoing review of needs for land use and land management information by these partners. Adequate resourcing and maintenance of skills within state and territory agencies are also important for updating catchment-scale land use mapping and for the maintenance of information products and the facilities that provide access to them.

ACLUMP has a critical role in maintaining a national commitment to consistency, while allowing flexibility sufficient to meet the particular needs of individual jurisdictions, and ensuring that needs at national, industry and regional levels continue to be appropriately serviced.

ACLUMP will work to:

- align national models of land use with catchment-scale land use mapping where it is current (i.e. where maps at a regional scale represent land use information in more detail or where there have been changes in land use in the period since the previous national map)

- ensure that other contributors, for example regional management authorities use national standards for any collection of catchment-scale data, especially where land use change in a region is rapid or widely distributed
- store, manage and disseminate data.

4. Land use change

A capacity to measure and report change in land use over time is critical to monitoring trends in natural resource condition and the effectiveness of public investment in natural resource management. ACLUMP is working towards establishing a national system for identifying, mapping and reporting land use change. The advanced statistical and modelling skills of ACLUMP members and access to current and accurate data ideally place ACLUMP to coordinate this national system.

At a national scale, current investigations are focused on the use of best available modelling methods, coupling time-series satellite image data and agricultural statistics to identify and report on change.

At the catchment scale, current efforts are focused on methods for identifying change in key catchments and, more specifically, on the use of remote sensing methods to report changes in pasture and cropping land use systems (see section 5).

Development of national land use change reporting capacity will focus on:

- identifying 'hotspots' for change in priority land uses, for example irrigation, cropping, improved pasture and major changes in land use, for example peri-urban development
- national standardisation of attributes, including change classification, across different scales
- testing and using advances in technology for remote sensing, image processing and image analysis (see section 7)
- protocols for distinguishing changes that are part of standard farming systems, from changes that reflect longer term trends and actual changes from apparent changes that are an artefact of the method of mapping
- linkages to other data collection procedures, for example purchase of irrigation entitlements by government authorities for environmental purposes.

Particular attention will be paid to progress by the ABS in assessing change in land parcels using cadastral information. There is also a pressing need for progress in the verification of identified changes and automation of procedures.

5. Land management practices

The classification, mapping and analysis of land management practices will remain a priority for ACLUMP because of the strong relationship between change to sustainable land management practices and natural resources outcomes.

Mapping will focus on practices that are used across a range of industries, have a significant influence on the condition of soil, land, water, the atmosphere and aspects of biodiversity and are linked to the long term sustainability of production. The priorities for the collection of information on land management practices are presented in the *Status of Land Management Practices Activities of the Australian Collaborative Land Use and Management Program*, Australian Collaborative Land Use and Management Program (2010).

The importance of recording information about ground cover is recognised in the Caring for our Country initiative – especially in its 2009–10 sustainable farm practice targets. 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 productive capacity, and increase the capacity of the land to recover from drought. Management and changes in management are critical elements for Australian agriculture as it adjusts to changing climatic patterns.

ACLUMP coordinates a national program that focuses on mapping characteristic patterns of ground cover maintenance (frequency and length

of bare ground through the annual cycle) in cropping and grazing systems. Outputs will form the basis for ongoing national monitoring and analysis of change in ground cover management under cropping and modified pasture land uses. Outputs will support investment in sustainable farm practices and subsequent monitoring and evaluation. The project will be implemented collaboratively by ACLUMP partners, building on existing national and state activities. An ACLUMP Technical Working Group has been established to advance the development and implementation of the program.

ACLUMP has developed the Land Use Management Information System (LUMIS) – a framework for the categorisation of land management practices – and has undertaken six pilot land management practices mapping projects in the states and territories. Reports on those projects are on the ACLUMP website. ACLUMP will further develop the LUMIS framework to ensure it delivers products able to meet data and information needs of government, industry and the research community by:

- consolidating the experience gained from the six pilot projects and releasing and promoting the LUMIS classification to potential data providers
- encouraging consistency within and across jurisdictions and ensuring capacity to include and integrate information being collected by other agencies and programs
- maintaining a focus on relationships between land use, land cover and land management practices and how they interlink and may change over time.

ACLUMP will work with stakeholders to:

- set priorities for data collation and presentation
- identify industry and other data collections containing information relevant to LUMIS
- promote the LUMIS framework to industry to enhance consistency in terminology and minimise duplication of effort
- negotiate data sharing protocols and agreements where appropriate
- develop, maintain, disseminate and deliver nationally consistent land management information products.

ACLUMP has developed plans for four projects in addition to ground cover which, if funded, could contribute land use and land management practices information to current policy priorities and build capacity and collaboration between stakeholders to improve future capability. Those projects address:

1. Rangelands grazing (stocking rates). Collation and mapping of land practice information for the rangelands, including animal type and numbers (feral and native), location and length of grazing, triggers for land management practice change; to be implemented in collaboration with key stakeholders (government, industry, regional bodies and landholders) using existing information sources.
2. Soils and nutrients. Establish priorities for investment in improved nutrient and soil management practices in terms of the potential benefit and feasibility of implementation; to characterise key processes and relationships (agricultural system, nutrient management regime, nutrient load, soils and landscape context, extension history, movement processes, externalities).
3. Water. Develop national water use efficiency layers discriminating key land use regimes (including forestry and dryland agriculture at 1 kilometre, irrigated agriculture and environment at 100 metres); results will provide for the analysis of 'hotspots' and assist targeting of investment.
4. Broadacre cropping. Land management practices mapping for broadacre cropping systems affecting soil condition (carbon), compiled at paddock scale and reportable regionally. A primary focus on tillage practices and animal movement. Mapping to be implemented in collaboration with key stakeholders (farmers, natural resource management bodies, industry groups) using existing information sources.

6. Land cover

ACLUMP is promoting the development of a nationally coordinated approach to land cover mapping for Australia through participation in a national land cover consortium to promote, develop and coordinate nationally consistent land cover information for Australia. This consortium is being progressed through the *Auscover* initiative led by CSIRO Marine and Atmospheric Research and Geoscience Australia through the Terrestrial Ecosystem Research Network (TERN). The benefits of this initiative will include improved imagery resources, an integrated network of reference sites, greater efficiencies in mapping programs, and a wider range of enhanced and better-integrated land cover products.

A national technical working group will be constituted under NCLUMI to coordinate input from the *Auscover* user community on priorities for land cover information products.

7. Research and technical innovation

Innovation is critical to ACLUMP's capacity to generate relevant, cost-effective and timely information products. To ensure ACLUMP is able to take advantage of the best available statistical and modelling methods, a research and technical innovation program is being established in partnership with CSIRO Mathematical and Information Sciences (Environmental Monitoring and Modelling).

This interdisciplinary activity stream will strengthen the national consortium, complement mapping work and other current technical working group activities, build analytical capacity, create new and improved products and broaden the client base. This activity stream will focus primarily on developing improved methods of data integration. This includes:

- improved satellite image classification techniques
- harnessing existing mapping and ancillary information to improve the accuracy of new land use mapping
- innovative use of ABS data (allowing for confidentiality requirements)
- change analysis and forecasting (e.g. likelihood of change, type of change, intensification)
- improved national-scale time-series mapping capacity.

Program coordination

ACLUMP is sponsored by the Australian Government Department of Agriculture, Fisheries and Forestry under national natural resource information coordination arrangements. The Australian Bureau of Agricultural and Resource Economics and Sciences has day-to-day responsibility for its development.

ACLUMP is advised by NCLUMI. Membership of NCLUMI includes Australian, state and territory government partners. General information about ACLUMP is maintained on a web site maintained by ABARES.

NCLUMI is supported by a Technical Advisory Group (TAGALUM), the members of which include Geoscience Australia, the Australian Bureau of Statistics and the Murray–Darling Basin Authority. Key issues considered at meetings of NCLUMI (and TAGALUM) include:

- national (continental) and catchment (regional) mapping programs
- data standards and methods for mapping land use and land management practices
- maintenance of an up-to-date national land use data directory
- custodianship of land use data sets by Australian, state and territory governments
- collaboration across natural resource management themes
- requirements for regional and national reporting
- assessment of emerging data needs and development of clients (e.g. information to support responses to climate change)
- technical developments and methods for the acquisition of land use, land cover and land management practice data
- analysis of land use change in collaboration with other interests.

NCLUMI meets annually and has teleconferences between annual meetings. TAGALUM operates through a series of technical working groups, each dealing with specific technical issues, including land use classification and mapping specifications, change detection and reporting, coordination issues with vegetation mapping, land management practices mapping, and research and technical innovation. A special technical working group has also been established under NCLUMI to coordinate user community input into the *Auscover* land cover initiative.

Contacts

Visit the ACLUMP website at

www.abares.gov.au/landuse

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Environment, Climate Change & Water

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CSIRO

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