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Reprint: Land Use and Management—The Australian Context¹

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Key Points

- Over the last 100 years there is an overall trend of land use intensification in Australia, although this varies regionally and is set against a slow decline in the proportion of Australia's land area used for agriculture.
- Australia's food supply system will continue to contribute to food security domestically and globally.
- Under the Australian Constitution, the state governments have prime responsibility for land administration and public land management. The Australian Government has a limited land ownership and management role. Its primary role is to promote more efficient land management and land allocation.
- Important themes of governance at the state level include urban and rural land zoning, forestry plantations, mining development and environmental regulations around native vegetation management.

¹ R. Lesslie & J. Mewett. (2013). *Land use and management: The Australian context* (Australian Bureau of Agricultural and Resource Economics and Sciences Research Report 13.1). Canberra, ACT. Retrieved from agriculture.gov.au/abares/publications.

- Improved data collection and analytical systems are needed for tracking ‘hotspots’ of land use change, including land use intensification on the fringes of cities and urban areas, and loss of productive agricultural land, productive land resources and biodiversity.
- Projected increased population will create further pressure for land use intensification for residential, commercial and production purposes.
- Australian and state governments have implemented a mix of programs and regulations to enhance land management and land use.

Introduction

Australia has unique land, water, vegetation and biodiversity resources. Australia’s 7.7 million square kilometres support a wide range of agricultural and forestry industries. Production from natural resources earns over \$38 billion a year in exports from agriculture, fisheries and forestry. Competitive pressures drive the need for improved productivity, which includes increased diversification and intensification. These trends are occurring against a background of increased climate variability.

The way in which land is used has a profound effect on Australia’s social and ecological systems. There is a strong link between changes in land use and environmental, economic and social conditions. Information on land use and management is fundamental to understanding landscapes, agricultural production and the management of natural resources.

Land use choices have a major effect on our food production, natural environment and communities. Land use change and land management are central to current debate in Australia around food security, water, climate change adaptation, population and urban expansion. Informed land use and land management choices are critical to developing effective responses to natural resource management priorities, such as biodiversity protection, sustainable and productive agriculture, water quality and quantity, salinity and food security.

Key Land Statistics

The pattern of land use in Australia is shown in Figure 3.1. The dominant land use is livestock grazing. This occurs mostly on native vegetation and makes up 56 per cent (or 4.3 million square kilometres) of Australia (see Table 3.1). Other agricultural uses, including broadacre cropping (almost 270,000 square kilometres or 3.5 per cent) and horticulture

(5,000 square kilometres or less than 0.1 per cent), occupy a much smaller proportion of land area. The total area of land under primary production in Australia (livestock grazing, dryland and irrigated agriculture) is nearly 4.6 million square kilometres or 59 per cent.

Approximately 569,240 square kilometres (or 7 per cent) of Australia is set aside for nature conservation. Other protected areas, including those for use by Indigenous Australians, cover more than 1 million square kilometres (or 13 per cent) of Australia. Forestry tends to be confined to regions with higher rainfall and covers nearly 2 per cent of the continent. Intensive uses (mostly urban) occupy about 17,000 square kilometres (or 0.2 per cent) of Australia.

Figure 3.1: National land use of Australia, 2005–06.²

Source: Bureau of Rural Sciences (2006).

2 Note: Since the original publication of this paper, a more recent land use product has been released for 2010–11. To view the updated map of land use of Australia, 2010–11, see www.agriculture.gov.au/abares/aclump/land-use/land-use-mapping.

Table 3.1: Land use in Australia, 2005–06.

Land use	Area km ²	Proportion of Australia %
Grazing native vegetation	3,558,785	46.30
Minimal use	1,242,715	16.17
Other protected areas, including Indigenous uses	1,015,359	13.21
Grazing modified pastures	720,182	9.37
Nature conservation	569,240	7.41
Dryland cropping	255,524	3.32
Water	125,618	1.63
Production forestry	114,314	1.49
Plantation forestry	23,929	0.31
Intensive uses (mainly urban)	16,822	0.22
Irrigated cropping	12,863	0.17
Irrigated pastures	10,011	0.13
Rural residential	9,491	0.12
Irrigated horticulture	3,954	0.05
Intensive animal and plant production	3,329	0.04
No data	2,243	0.03
Waste and mining	1,676	0.02
Dryland horticulture	1,092	0.01
Total	7,687,147	100.00

Source: Australian Bureau of Agricultural and Resource Economics and Sciences—Bureau of Rural Sciences (2010).

History

The Aboriginal occupation of Australia has been associated with the systematic burning of vegetation to increase the availability of plant and animal foods and reduce fuel for wildfires (Gammage, 2011). Since European settlement about two centuries ago, Australia's landscapes have changed significantly. European settlement began with early pastoralism, cropping and prospecting, and has led to today's major agricultural, forest and mining industries, reserve landscapes and urban communities. Land use change over this period was driven by relatively unrestricted access to land, technological change and growth in productivity and population.

More recently, land has been increasingly managed for multiple objectives, including food, fibre, minerals, energy, landscape amenity, water, carbon and biodiversity. A well-managed landscape provides high-quality and essential ecosystem services to farmers and the Australian community. Australian governments have implemented a mix of programs and regulations to enhance land management and use. The Australian Government has also invested in programs to improve land management practices, such as the Natural Heritage Trust, the National Action Plan for Salinity and Water Quality and Caring for our Country.

Current Situation

Policy–Legislation Framework

Significant areas of Australia are used for livestock grazing on native pastures. This may be freehold or public land leased by private landholders. Agricultural uses—including cropping and livestock grazing on improved pastures, urban uses, other intensive uses and Indigenous uses—are mainly located on privately owned (freehold) land. Most land allocated to forestry (native forests) and nature conservation is publicly owned and managed.

Australia has six states and two mainland territories. Under the Australian Constitution, the state governments have primary responsibility for land administration and public land management. The Australian Government has a limited land ownership and management role. Its primary role is to promote more efficient land management and land allocation. An example is the National Forest Policy process, which has established a nationally agreed basis for determining forest assessment and resource allocation principles, resource inventory and national reporting. There are similar national coordination processes for nature conservation; for example, through the National Reserve System. Important themes of governance at the state level include urban and rural land zoning, forestry plantations, mining development and environmental regulations around native vegetation management.

There are three key challenges:

1. Land use governance and tenure arrangements need to accommodate multi-objective land use and land management options. Modern approaches to nature conservation include joint management and partnership arrangements that can simultaneously provide for multiple uses; these can include biodiversity protection, recreation uses, Indigenous cultural uses, mineral exploration, mining and grazing production.
2. Land use and land management incentives for non-market ecosystem goods and services may play an important role; these may be applied where these goods and services are not adequately reflected in market systems.
3. Sufficient data and information are required to support informed land use and management planning. This includes decision support capability to enable informed and transparent consideration of options and trade-offs.

Agricultural Land Management

In 2007–08, the Australian Bureau of Statistics (ABS) surveyed farmers about their land management practices. Table 3.2 shows characteristics of Australian farms broken into four major industries: broadacre cropping, horticulture, dairying and grazing (beef cattle, sheep meat).

Innovation in Australian agriculture has generally driven enough growth in productivity to offset consistently declining agricultural terms of trade. Innovation, through improved land management practices, has also increased agriculture's ability to lessen threats to soil, water resources and biodiversity. Land management practices can bring about the changes needed for sustainable use of Australian landscapes. For example, conservation tillage helps to improve soil carbon, reduce soil erosion and nutrient loss, and increase cost savings and other production benefits. Of agricultural businesses preparing land for crops or pastures, 40,000 (53 per cent) reported using no tillage over a total of more than 170,000 square kilometres in 2007–08. Figure 3.2 shows how tillage management practices differ across the country.

Table 3.2: Summary of characteristics and management of Australian farm businesses (farmers).

Farm business characteristics and management	Broadacre cropping	Horticulture	Dairying	Grazing (beef cattle, sheep meat)
Farm business characteristics				
Average age	54	53	53	55
Average years managing holding	24	19	22	23
Farm management plans (formal and informal)				
Production management	56,891 (81%)	13,934 (59%)	8,270 (83%)	75,579 (82%)
Business financial	51,371 (73%)	15,490 (65%)	7,796 (79%)	64,734 (70%)
Extreme circumstances	47,800 (68%)	12,994 (55%)	7,502 (76%)	64,123 (69%)
Natural resource management	42,215 (60%)	11,887 (50%)	6,557 (66%)	56,537 (61%)
Succession	39,593 (57%)	10,705 (45%)	6,055 (61%)	49,996 (54%)

Note: Numbers in brackets represent the proportion of farmers adopting farm plans by enterprise type.

Source: Australian Bureau of Statistics (ABS, 2008).

Figure 3.2: Cultivation practices by natural resource management region.

Note: Refers to cultivation practices used to prepare crops and pastures as a percentage of the area prepared for crops and pastures, by natural resource management region.

Source: ABS (2009).

Natural Resources

Water

Long-term average annual rainfall varies across Australia from less than 300 millimetres per year in most of Central Australia to more than 3,000 millimetres per year in parts of Far North Queensland (see Figure 3.3).

Figure 3.3: Mean annual rainfall of Australia.

Source: Department of Agriculture, Fisheries and Forestry (DAFF, 2008).

Of all inhabited continents, Australia has the lowest proportion of rainfall going into its rivers and aquifers—11 per cent compared with the world average of 65 per cent. About 65 per cent of run-off occurs in far north Australia and coastal Queensland (see Figure 3.4). By contrast, only 6.8 per cent of Australia's run-off occurs in the Murray–Darling Basin, although more than 50 per cent of Australia's water use occurs there. The seasonal distribution of rainfall also varies widely—run-off in northern Australia occurs predominantly in the monsoonal wet season, while run-off in the Murray–Darling Basin is spread throughout the year.

Figure 3.4: Long-term average run-off from Australia's drainage divisions.

Source: DAFF (2012).

Irrigation is a well-established and important feature of the agricultural landscape, especially in the Murray–Darling Basin. In 2007–08, 90 per cent (6,285 gigalitres) of the water used by agricultural industries was used to irrigate crops and pastures, while 10 per cent (704 gigalitres) was used for other agricultural purposes. Water use for irrigation, industry and urban needs has placed pressure on water-dependent ecosystems. The challenge is using water for production purposes while maintaining water quality and conserving the natural environment. A national program of water reform is being implemented to achieve this balance.

Soils

The agricultural landscape in Australia includes a wide range of soil types, ranging from old, deeply weathered and infertile soils to younger and more fertile soils (see Figure 3.5) (McKenzie et al., 2004).

Figure 3.5: Australian soil types.

Source: DAFF (2012).

Important soil management issues include erosion (wind and water), salinisation (dryland and irrigation), acidification and compaction. Soils are managed by maintaining ground cover and windbreaks, avoiding steep slopes, applying fertilisers (mainly phosphorus and nitrogen) and using lime and gypsum to manage soil condition and pH.

Vegetation

Australia's native vegetation estate comprises shrublands and heathlands (37 per cent), native grasslands and minimally modified pastures (33 per cent) and native forests and woodlands (19 per cent). The remaining 10 per cent of the continent comprises non-native vegetation, such as annual crops and modified pastures (9 per cent) and plantations (0.2 per cent) (see Figure 3.6).

Figure 3.6: Australian vegetation.

Source: DAFF (2012).

In areas with higher rainfall and more fertile soils, native vegetation has been extensively cleared and replaced with intensive agriculture. In these landscapes, remnants of native vegetation and non-native vegetation exist as a mosaic of vegetation types. In areas with lower rainfall, much of the native vegetation remains and supports pastoral industries. Providing water (i.e. bores) has enabled extensive development of these rangelands.

The clearing of native vegetation has declined since the 1990s, as states and territories introduced regulatory controls. Vegetation management can profoundly affect landscape condition, soil health and the supply of ecosystem goods and services, such as food, fibre and water production. The importance of managing vegetation for ecosystem goods and services is reflected in on-the-ground investments being made through conservation programs, land clearing controls and environmental management systems.

Environment Protection

Government Programs

The Australian Government's central piece of environmental legislation is the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC). It provides a legal framework for protecting and managing flora, fauna, ecological communities and heritage places that are defined as matters of national environmental significance. The objectives of the EPBC are to:

- provide for the protection of the environment, especially matters of national environmental significance
- conserve Australian biodiversity
- provide a streamlined national environmental assessment and approvals process
- enhance the protection and management of important natural and cultural places
- control the international movement of plants and animals (wildlife), wildlife specimens and products made or derived from wildlife
- promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources.

Environment protection objectives are also pursued by the Australian Government under the Caring for our Country initiative, which supports the environmental management of natural resources. The Caring for our Country initiative addresses six national priority issues:

1. expanding Australia's National Reserve System
2. addressing threats to biodiversity and natural icons
3. managing and protecting coastal environments and critical aquatic habitats, including the Great Barrier Reef
4. encouraging farmers to adopt sustainable farm practices
5. promoting sustainable natural resources use and environmental protection in northern and remote Australia
6. supporting and increasing community skills, knowledge and engagement.

This initiative supports regional natural resource management groups; local, state and territory governments; Indigenous groups; industry bodies; land managers; farmers; Landcare groups; and communities.

Outlook

Climate Change

Australia's climate is changing as part of a global trend. Climate change is expected to continue and perhaps accelerate, presenting both challenges and opportunities for Australian agriculture. The effects of climate change will vary across sectors and regions, altering risk profiles both positively and negatively. Adapting to climate change will require information systems that identify the effects of climate change alongside other business management risks.

Agriculture is the dominant source of both methane and nitrous oxide emissions in Australia. Most agricultural emissions come from livestock (methane), burning of savannas and nitrous oxide emissions from soils.

Pests, Diseases and Weeds

More than 80 species of exotic vertebrate animals have established wild populations in Australia and more than 30 of these species have become agricultural or environmental pests. Major agricultural impacts of pest animals include:

- grazing and land degradation by rabbits and feral goats
- livestock predation by wild dogs, foxes and feral pigs
- damage to grain and fruit crops by mice and birds.

The direct costs to agriculture (including pest impacts and expenditure on management, administration and research) from wild dogs, rabbits, foxes, pigs, pest birds and mice was estimated to be approximately \$745 million in 2009 (Department of Agriculture, Fisheries and Forestry [DAFF], 2012). Introduced insects, such as cattle ticks and aphids, cost agriculture more than \$5 billion per year in production losses and \$1 billion in control costs (DAFF, 2012).

Around 28,000 exotic plant species have been introduced into Australia since European settlement, and 3,480 of these have become weeds. Many of these weeds are escaped garden plants. Weeds contaminate crops, displace pasture plants and compete with crop and pasture plants for water and nutrients. Weeds also harbour diseases and insect pests, reduce livestock carrying capacity and condition and can be toxic to livestock.

The effect and control of weeds costs Australian agriculture more than \$4 billion per year (DAFF, 2012). Farmers consider weed control one of their highest priorities in the prevention of long-term land degradation.

Biosecurity

Australia's biosecurity system minimises the risk of exotic pests and diseases entering the country and harming the natural environment. Australia's expanding economic ties with developing regions have led to inherent biosecurity risks. Warmer climates and faster transport systems can encourage pests and disease. Within Australia, disease and pest security is also increasing with climate change and improved logistics. The Australian Government is implementing reforms to Australia's biosecurity system to ensure it is responsive and targeted in a changing global trading environment.

Land Use

There is an overall trend of land use intensification in Australia, although this varies regionally and is set against a slow decline in the proportion of Australia's land area used for agriculture. According to ABS data, the area planted to crops (excluding pastures and grasses, and crops harvested for hay and seed) increased between 1992–93 and 2009–10, from almost 17.3 million hectares to almost 26 million hectares. Projected increases in population will create further pressure for land use intensification for residential, commercial and production purposes. The potential effect of climate change on agriculture and the possible contraction of food-producing areas, such as the Australian wheatbelt, will add to this pressure.

The causes and drivers of land use change are:

- pressures on resource availability, including land productivity, resource condition and population
- changing opportunities, including market development, production costs, new technologies, infrastructure and transport costs
- policy interventions, including subsidies, taxes, property rights, infrastructure and governance arrangements
- vulnerability and adaptive capacity, including exposure to natural hazards and the coping capacity of communities and individuals
- social changes, including changes in access to resources, income distribution and urban–rural interactions.

Land use change needs to be monitored to manage Australian landscapes and implement policy settings and program arrangements dealing with agricultural productivity, biosecurity, carbon, natural resources management, biodiversity and food security.

Australia is improving its capacity to track land use change, drawing on information such as satellite remote sensing and statistical collections. The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) is working with the Australian Collaborative Land Use and Management Program's (ACLUMP) partners to promote collaboration among federal and state government agencies and others with interests in land use change analysis. The recent move by the Australian Government to establish a National Plan for Environmental Information, and by the ABS to introduce land and water accounting, will further promote tracking and reporting on land use change.

More recent statistical evidence from the ABS confirms this general pattern of change in agricultural land uses. Between 1992–93 and 2005–06, the area of agricultural holdings decreased by 5.5 per cent to 4,349,250 square kilometres. The most recent ABS information for 2009–10 shows that the area of land used for agriculture has continued to decline, to 3,985,800 square kilometres (a 13.4 per cent decrease from 1992–93). The area planted to crops (excluding pastures and grasses, and crops harvested for hay and seed) increased by 42 per cent between 1992–93 and 2005–06, and by 50 per cent between 1992–93 and 2009–10 (see Figure 3.7).

Figure 3.7: Agricultural land use change, 1992–93 to 2009–10.

Source: Lesslie, Mewett & Walcott (2011).

However, there is considerable variability in the spatial distribution of change across Australia over the period. For example, from 1993–94 to 2005–06, there was an increase in cropping area on the western slopes of New South Wales, western Victoria and generally across the grain-growing regions of South Australia and Western Australia (see Figure 3.8). There was a small decline in the area under cropping across most of northern New South Wales and southern Queensland.

Figure 3.8: Change in area cropped, 1993–94 to 2005–06.

Source: Lesslie, Mewett & Walcott (2011).

In some cases, land use change can be represented as a process of land use intensification. Agricultural land use intensification is one response to the challenges of the cost-price squeeze faced by agricultural producers and increasing population. It reflects the attempt to secure more economic yield from each hectare through increasing concentrations of inputs, including nutrients, water, energy and management effort.

Agricultural land use intensification in Australia is illustrated in Figure 3.9, expressed as the cost of production per unit area. Intensification is generally concentrated in the more agriculturally productive regions that have a greater range of viable land use options, including opportunities for irrigation. Agricultural land use intensification is also concentrated in and around large population centres.

Figure 3.9: Change in agricultural land use intensification, 1985–86 to 2005–06.

Source: Lesslie, Mewett & Walcott (2011).

Table 3.3: Weighting factors

Land use category	Representative industry	Weighting factor
Residual or extensive grazing	Beef cattle	1
Sown pastures	Sheep/beef cattle	2
Grain crops	Grains	10
Irrigated pastures	Dairy cattle	40
Irrigated crops	Cotton, sugar cane, rice	50
Vegetables	Vegetables	80
Fruit	Fruit	80
Nurseries/turf	Horticulture	80

Note: Weighting factors for land use categories and representative industries used to calculate land use intensity index.

Source: Lesslie, Mewett & Walcott (2011).

Statistical collections from the ABS Agricultural Census and Agricultural Resource Management Surveys indicate that major changes in farm management practices are underway. For example, there has been a shift to conservation tillage over the past 15 years in broadacre cropping (see Figure 3.10). Conservation tillage helps promote improvements in soil carbon, reduced soil erosion and nutrient loss, cost savings and other production benefits. In 1996, conventional tillage (three or more cultivation passes) was the most common practice by area in all states except Western Australia and South Australia. By 2010, it was the least common practice in all states—‘no cultivation’ had replaced it as the most common cultivation practice.

Figure 3.10: Cultivation practices for crops and pastures, 1995–96 to 2009–10.

Source: ABS (2010a, 2010b).

Ecosystem Services

An ecosystem services approach integrates the ecological, social and economic dimensions of natural resources management, including conservation and production objectives, by explicitly identifying and classifying the benefits from ecosystems. These include market and non-market, use and non-use, and tangible and intangible benefits.

The ecosystem services concept has been used successfully in Australia and internationally to identify natural resource management priorities at the catchment, regional, national and global scales, and to report on the relationship between the environment and human wellbeing. For nearly two decades, it has been a component of Australian Government policies and programs focused on sustainable management and development. For example, ecosystem services were a feature of the policies and programs that flowed from the National Strategy for Ecologically Sustainable Development, especially the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality. The ecosystem services concept is also identified in the overarching goal of the Caring for our Country initiative.

The ecosystem services approach is particularly relevant to using and managing land cover. Land cover is related to a range of ecosystem services, such as helping to regulate water flow and maintain water quality. Such services have traditionally been treated as public goods with little or no explicit financial value, but this is changing. Potential payments for vegetation-based services, such as biodiversity conservation, carbon sequestration, salinity abatement and opportunities for ecotourism, wildlife photography and environmental education, can provide significant environmental, economic and social benefits and contribute to reducing the cost of management. While markets for such services remain a minor component of the national economy, they are expected to grow.

Research Capacity—Land Use and Management

ABARES provides professionally independent economic and scientific analysis, including integrated socio-economic and biophysical analysis that informs the difficult policy issues facing Australia's primary industries.

It has staff with skills across a range of economic, science and social science disciplines. These include scientific and economic analysis and modelling; data (including survey) collection and statistical analysis; risk assessment and management; geographical mapping, particularly in areas related to natural resource management; commodity and market analysis; and integrated analysis.

ABARES has an established capacity to compile national land use, land management and land cover information, and track change using regular statistical collections by government and industry and remotely sensed imagery. These types of information are combined to take advantage of their complementary spatial and temporal characteristics—for example, in the national-scale land use mapping produced by ABARES.

Tracking and Reporting Change

ABARES is working with ACLUMP partners to promote collaboration among state and federal government agencies and others with interests in land use change analysis. Australia's large land area means that remote sensing is an attractive option for cost-effective mapping of aspects of land use change. Free access to imagery archives, such as Landsat, MODIS (Moderate Resolution Imaging Spectroradiometer) and AVHRR (Advanced Very High Resolution Radiometer), has resulted in ready uptake in mapping programs. Agricultural statistics compiled by the ABS and ABARES are also important sources of information for analysing and reporting change.

National Land Use Mapping

National-scale land use mapping is modelled using coarse-scale satellite data (pixel size of 1.1 square kilometres): ABS Agricultural Commodity Census statistics for agricultural land uses; pre-existing finer resolution data (principally at the 1:250,000 scale) for other uses. The relatively low cost of national mapping provides an opportunity for time-series mapping. National-scale (1:2,500,000) datasets have been completed for 1992–93, 1993–94, 1996–97, 1998–99, 2000–01, 2001–02 and 2005–06 (see Figure 3.1 for the most recent map). The next national-scale dataset will be based on the 2010–11 Agricultural Commodity

Census. National-scale mapping produced by ABARES is in strong demand for synoptic-level land use assessments, and for strategic planning and evaluation (such as developing programs for natural resource management). It is also used in modelling applications, such as national carbon accounting and salinity assessments, at the river-basin level.

Dynamic Land Cover Mapping

A dynamic land cover map and databases for Australia produced by Geoscience Australia in partnership with ABARES provide new insights into aspects of land use and land management change for Australia. The map and time-series data, produced for 2000–08 by ABARES using MODIS EVI (Enhanced Vegetation Index) data, allow trends and changes in land cover over time to be investigated. This database can provide insight into the response of land cover to a wide variety of drivers—both natural and anthropogenic. This allows natural resource managers to identify emerging patterns of land cover change, and provides a broad spatial and historical context within which to interpret that land cover change.

Ground Cover Monitoring for Australia

Ground Cover Monitoring for Australia is a national program, coordinated by ABARES, that involves the remote sensing of fractional cover (i.e. green cover, dry cover and bare ground) across Australia using MODIS NBAR (Nadir Bi-directional Reflectance Distribution Function Adjusted Reflectance) data. The program includes the establishment of a national system of ground validation sites using nationally agreed methods. The data are being used initially to support soil erosion modelling, and it is intended that this will be extended to mapping management practices (such as tillage and stubble management) in the cropping zone. Partners include key national research organisations (i.e. Commonwealth Scientific and Industrial Research Organisation [CSIRO], Geoscience Australia and Terrestrial Ecosystems Research Network) and natural resources management or agriculture departments in each state.

Land Management Practices

Land management practices are analysed primarily using agricultural statistics collections, such as those of the ABS and ABARES. In 2007–08, the Agricultural Resource Management Survey was conducted by the ABS

to provide a baseline of key practices to help guide national investment programs to improve natural resources management. Practices include those relating to tillage, stubble management, ground cover management, fertiliser use, soil testing and liming. This survey was also run for 2009–10, and will be run again for 2011–12. These results will be used to measure change in land management practices over time.

ABARES carries out a smaller annual survey—the Australian Agricultural and Grazing Industry Survey—of the broadacre cropping, grazing and dairy industries. This survey produces estimates of land area and tenure, labour, farm capital, crop type and production, fertiliser use, irrigation, farm receipts, farm costs, farm performance measures, farm debt and farm equity.

Spatial Decision Support

The Multi-Criteria Analysis Shell for Spatial Decision Support (MCAS-S), developed by ABARES, is an easy-to-use spatial decision support tool designed to help visualise and combine mapped information in a flexible, interactive way. MCAS-S is the latest of several multi-criteria decision support aids used by DAFF since the early 1990s to support policy decision-making.

MCAS-S allows the user to import, select and display spatial data in a dynamic workspace window, see multiple datasets simultaneously, group datasets under themes, interactively modify and combine datasets, and carry out two-way and multi-way comparisons to form meaningful map-based flow diagrams. Layers can be combined using simple weights, complex functions or through pair-wise comparison. It also allows users to document their results and the decision-making process, including assumptions.

A project can be constructed at any scale and resolution and ‘live updates’ are available, which are particularly helpful at workshops. MCAS-S assists in decision-making in situations in which transparency between different approaches to map combinations is needed. Stakeholders can see the effects their decisions may make. Successful use of the software does not require geographic information system (GIS) programming, which removes the usual technical obstacles non-GIS users have in accessing and analysing spatial information.

MCAS-S is being used at the national, regional and catchment scale for:

- wind erosion extent and risk assessment, 2009
- soil acidification risk assessment, 2010
- soil carbon potential evaluation, 2009
- targeting investment—Great Barrier Reef water quality, 2009–10
- indicators of community vulnerability and adaptive capacity, 2010
- rabies risk mapping, 2011
- weeds risk assessment, 2011
- Asian honey bee risk assessment, 2009
- animal disease risk mapping, 2011
- revegetation planning, 2006
- land acquisition priorities for conservation, 2010
- catchment revegetation planning, 2011
- priorities for regional natural resources investment, 2011
- wildfire assessment (soil erosion), 2011
- agricultural land quality evaluation, 2011.

Figure 3.11 shows data layers that have been combined using MCAS-S to produce a national map of the extent and severity of wind erosion. These data included modelled wind erosion data (created using a model), an index of dust storm activity based on observed data, and expert opinion (rankings by region) of the extent and severity of wind erosion. The input data layers were weighted for each state according to expert opinion on their confidence in each layer, and were combined spatially using the MCAS-S tool. The darker areas are those with the highest wind erosion extent and severity in Australia, as determined by an expert panel.

Figure 3.11: Multi-Criteria Analysis Shell for Spatial Decision Support project screenshot to determine the extent and severity of wind erosion in Australia.

Note: The states were analysed individually and then combined to provide a national picture.

Source: Smith & Leys (2009).

Key Issues

This chapter was originally prepared as a background paper as part of a collaborative project between ABARES and the Forestry Economics and Development Research Center of China's State Forestry Administration to develop a sustainable land and forest management research agenda.

Several potential issues in the land use and resources area were identified as context for discussions between ABARES and the China National Forestry Economics and Development Research Center on common technical interests. These include:

- Australia's food supply system and its potential to contribute to food security domestically and globally
- where and how sustainable agriculture can be maintained and developed in response to climate change and loss of productive agricultural land
- options for managing carbon in Australian agricultural production systems (including farm forestry)
- tracking 'hotspots' of land use change, including land use intensification on the fringes of cities and urban areas, and loss of productive agricultural land, productive land resources and biodiversity
- transitions in irrigated agriculture, forestry and carbon farming, and the trade-offs between biofuels and other forms of agriculture.

Addressing these issues will require:

- more effective use of newly available remote sensing and statistical information
- new methods for change analysis (including automated change detection), and better measurement of error and uncertainty
- better links between existing data collection and analysis activities, including international engagement
- better methods for identifying and classifying thematic transitions, cyclic variability and trends
- better methods for forecasting land use change, including change in response to increased climate variability and disaster risk (e.g. biosecurity, fire, flood and cyclone)

- land use and land management incentives for non-market ecosystem goods and services
- decision support capability to enable informed, transparent consideration of options and trade-offs.

Potential Areas for Collaboration

The Sustainable Land and Forest Management Research Agenda project has strengthened technical cooperation in areas of common interest. To further improve the sustainable management of land and forests, potential areas for collaboration have been identified. These include:

- spatial decision support systems
- land resources assessment
- landscape classification
- ecosystem services
- remote sensing of land use and land cover change
- climate change adaptation
- carbon accounting relating to land use and land management change.

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