Integrated catchment management in the Murray-Darling Basin

A process through which people can develop a vision, agree on shared values and behaviours, make informed decisions and act together to manage the natural resources of their catchment: their decisions on the use of land, water and other environmental resources are made by considering the effect of that use on all those resources and on all people within the catchment.

Our values
We agree to work together, and ensure that our behaviour reflects the following values.

Courage
• We will take a visionary approach, provide leadership and be prepared to make difficult decisions.

Inclusiveness
• We will build relationships based on trust and sharing, considering the needs of future generations, and working together in a true partnership.
• We will engage all partners, including Indigenous communities, and ensure that partners have the capacity to be fully engaged.

Commitment
• We will act with passion and decisiveness, taking the long-term view and aiming for stability in decision-making.
• We will take a Basin perspective and a non-partisan approach to Basin management.

Respect and honesty
• We will respect different views, respect each other and acknowledge the reality of each other’s situation.
• We will act with integrity, openness and honesty, be fair and credible and share knowledge and information.
• We will use resources equitably and respect the environment.

Flexibility
• We will accept reform where it is needed, be willing to change, and continuously improve our actions through a learning approach.

Practicability
• We will choose practicable, long-term outcomes and select viable solutions to achieve these outcomes.

Mutual obligation
• We will share responsibility and accountability, act responsibly, with fairness and justice.
• We will support each other through the necessary change.

Our principles
We agree, in a spirit of partnership, to use the following principles to guide our actions.

Integration
• We will manage catchments holistically; that is, decisions on the use of land, water and other environmental resources are made by considering the effect of that use on all those resources and on all people within the catchment.

Accountability
• We will assign responsibilities and accountabilities.
• We will manage resources wisely, being accountable and reporting to our partners.

Transparency
• We will clarify the outcomes sought.
• We will be open about how to achieve outcomes and what is expected from each partner.

Effectiveness
• We will act to achieve agreed outcomes.
• We will learn from our successes and failures and continuously improve our actions.

Efficiency
• We will maximise the benefits and minimise the cost of actions.

Full accounting
• We will take account of the full range of costs and benefits, including economic, environmental, social and off-site costs and benefits.

Informed decision-making
• We will make decisions at the most appropriate scale.
• We will make decisions on the best available information, and continuously improve knowledge.
• We will support the involvement of Indigenous people in decision-making, understanding the value of this involvement and respecting the living knowledge of Indigenous people.

Learning approach
• We will learn from our failures and successes.
• We will learn from each other.
Current recommended practice
A DIRECTORY FOR BROADACRE DRYLAND AGRICULTURE

Craig Clifton, Camille McGregor, Roger Standen & Simon Fritsch
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**Sources used in the preparation of current recommended practice documentation**: 49
Figure 1 Map of the Murray-Darling Basin showing the Landmark Pilot regions

Map produced by MDBC using data supplied by AUSLIG (Geoscience Australia)
Introduction

This directory

This directory contains a list of land management practices currently advocated by industry and practised by leading farmers for the major dryland agricultural land uses (grazing and cropping). The directory is intended as a reference for professionals in the field: agricultural extension officers, rural educators, representatives of producer organisations and commodity councils, community groups, researchers, consultants and state agriculture and natural resource managers. The application of a recommended practice at a particular time and place will need further information and detailed consideration.

The Murray-Darling Basin

Dryland agricultural land use across the Murray-Darling Basin is facing several major challenges:

* continued expansion in the area affected by dryland salinity and a decline in water quality in the lower Murray River and some of the Basin’s other major river systems;
* an ageing farming population, with limited prospects for property transfer within farming families;
* income earned by farming families, particularly in broadacre dryland farming enterprises, is often insufficient to maintain investment in the farm business and environmental management activities;
* most primary producers are price takers and have no mechanism to ensure prices they receive for commodities reflect costs associated with sustainable management of natural resources; and
* population drift in some rural regions, the loss of social and commercial infrastructure and declining development opportunities in small rural communities.

Without intervention, these trends are likely to continue and to result in a progressive degradation of the environmental, social and economic resources of the Basin, and of the nation as a whole.

The Landmark project

This directory was developed to inform the Murray-Darling Basin Commission’s (MDBC) Landmark project. Landmark is assessing the future of broadacre dryland agricultural land uses in the Basin. The project will consider whether current land use and the application of current recommended practice in dryland regions is sustainable – in environmental, social and economic terms. It will contribute to the development of policy options to achieve more sustainable land use.

Landmark investigations are being undertaken in three pilot regions with contrasting land uses before considering their application to the whole Basin (Figure 1). The three pilot regions are:

* Upper Goulburn-Broken catchment, Victoria – predominantly high rainfall (more than 600mm) grazing landscapes in the south and east of the Goulburn-Broken catchment. The area includes most of the land south of the Hume Highway in the Goulburn and Broken River catchments as well as the Kimmor and Broadford areas, north of the highway.
* Billabong Creek catchment, New South Wales – cropping and grazing landscapes of the upper Billabong catchment in southern New South Wales, between the Murrumbidgee and Murray Rivers. The pilot region extends downstream from the headwaters of Billabong Creek to Walbundrie.
* Condamine-Central Downs region, Queensland – cropping and grazing landscapes, largely within the middle reaches of the Condamine River catchment in south-eastern Queensland.

The Landmark project is overseen by a steering committee with membership drawn from rural industry organisations, including:

* Australian Forest Growers
* Australian wool industry
* Cattle Council of Australia
* Grains Council of Australia
* National Farmers’ Federation
* Sheepmeat Council of Australia
* Murray-Darling Basin Commission (MDBC)
* Community Advisory Committee of the Murray-Darling Basin Ministerial Council
* Australian Local Government Association

There will be three key outputs for the project as a whole. The first will be methods for assessing biophysical, economic and social sustainability of current land use and management practice. The second will be a series of reports that document the results and implications of implementing the methods in the three Landmark pilot regions. The final major output will be a series of policy options that can be implemented by...
governments, industries and communities to achieve more sustainable land use. It is intended that the policy options will be considered by the Murray-Darling Basin Ministerial Council in 2004.

**Key broadacre land uses**

The first phase of the Landmark project identified the broadacre agricultural land uses at the scale of the Murray-Darling Basin (Figure 2). Land use in this context was identified according to industry or commodity type, rather than to the prime use of land, and level and type of modification of natural land cover, as is commonly used. Based on both value of agricultural production and the area of land farmed, there are four main broadacre dryland agricultural land uses in the Basin:

* wool growing;
* sheepmeat production;
* beef production;
* cropping for cereal, grain legume and oilseed production.

It is recognised that other forms of dryland agricultural land use occur throughout the Basin, including rain-fed cotton growing, dairying, horticulture and forestry. Although such enterprises may contribute substantially to the regional gross value of agricultural production, their extent is generally limited and they are often supported at the property level by partial irrigation.

Across the Basin, the four land uses listed above are practised across almost all of the non-irrigated agricultural and pastoral land. The Landmark project, in this testing phase, addresses only these main land uses in its current work of developing and testing methods for assessing sustainability.

**Sustainable farming**

A sustainable farming system may be defined by resilience, in the sense that it:

* ensures the long-term maintenance or improvement in condition or quality of the basic resources employed (Table 1);
* has flexibility to allow response to the challenges and opportunities presented by short-term variation in, for example, climate and markets; and
* is adaptive and open to continuous improvement as the nature of the basic resources change (for example, through technological improvement, climate change, or change in community values).

| Table 1 Basic resources employed in broadacre dryland agriculture |
|-----------------------------|------------------|
| **Natural resources**       | **Human and social resources** |
| Land or soil                | Human effort, values and beliefs |
| Water                       | Knowledge, information and technology |
| Air and climate             | Financial capital and markets |
| Sunlight or solar energy    | Cultural heritage |
| Natural ecosystems          |                                |
| – native plants, animals    |                                |
| and natural ecological      |                                |
| processes                   |                                |
| Genotype of plants and      |                                |
| animals                     |                                |

While it is difficult to comprehensively define the specific outcomes of a sustainable farming system or sustainable agricultural land use, it is possible to define the goals that such a system might be seeking to achieve. The Landmark project has defined seven key goals for sustainable agricultural land use (Table 2).

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These sustainability goals broadly address environmental condition and the social and economic well-being of primary producers and their communities. They are in keeping with the Murray-Darling Basin Commission's Integrated Catchment Management (ICM) Policy Statement. The sustainability goals apply at a range of scales, from farm to region to nation.

**Current recommended practice**

Management practices in farming systems are the tools by which basic natural, human and social resources are employed to achieve the goals desired by the landowner or manager. One of the core activities of the Landmark project has been to define a comprehensive suite of management practices for the key broadacre agricultural land uses in the Murray-Darling Basin. Specific current recommended practices, across 24 broad areas of management practice, have been defined. They are the: specific management practices that are recommended by industry and adopted by at least some leading producers to achieve land use that is more sustainable from economic, social and/or environmental perspectives.

For the purposes of the project, industry has been very broadly defined. It includes, for example, producer organisations, commodity councils, research and development corporations, consultants and state agriculture and natural resource management agencies and research institutes.

The term current recommended practice avoids some of the unnecessary connotations associated with best practice or best management practice by explicitly recognising that farming practice operates in a changing biophysical, social, financial and technological context. In this operating environment, what is regarded to be best management practice is likely to change over time and space. While the management practices described in this report are intended to improve the sustainability of land use, their recognition as current recommended practice is not intended to imply that this will always be the case.

Current recommended practices were defined through literature survey, consultation with industry (defined above) and the expertise of project team members. It is presented in this document at a generic level, as it might apply across the major agro-ecological zones of the Basin and at a whole-of-industry level.

At this broad level, most of the described practices relate to all four of the major land uses studied by the Landmark project and are relevant across the dryland agricultural regions of the entire Basin. Clearly they are not equally important in achieving sustainable land use.

Within the three Landmark pilot regions, additional work has been undertaken to describe current recommended practice. That work has concentrated on a subset of management practices, which differed between regions. As might be expected, those differences are most pronounced in practices relating to the agricultural production system and environmental management.

It must be reinforced at this point that implementing the appropriate management practices does not guarantee sustainable land use. Indeed, one of the critical tasks of the Landmark project is to identify whether combinations of location and land use within the three pilot regions, even with full adoption of current recommended practices, would lead to the economic, social and environmental sustainability sought by Basin communities.

**Descriptions of current recommended practices**

This section provides broad descriptions of each of the 24 management practices for sustainable broadacre dryland agricultural land use. The description of each management practice provides the following information:

* a short definition of the practice;
* a brief description of the major elements associated with the practice;
* details of implementing the practice;
* a list of the benefits of implementation;
* a graphic showing the links between the management practice and sustainability goals; and
* further information.

A management practice may relate to one or more sustainability goals. Sustainability goals are labelled as either primary or secondary drivers. Primary drivers are those for which achieving the sustainability goal is a primary reason behind implementing the particular management practice. Secondary drivers are those goals that would benefit from the implementation of the management practice undertaken for some other reason.

A consolidated listing of the relationships between management practices and sustainability goals is given in Table 3 overleaf.
| Management practice                  | Definition                                                                                                                                                                                                 | Sustainability goals                                                                 |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| 1 Agroforestry                      | Management of trees and other woody perennials within agricultural systems for multiple environmental and economic objectives                                                                                 | Cultural heritage                | Financial return                | Greenhouse and air quality      | Nature conservation             | Quality of life                  | Soil health                     | Water quality and quantity       |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |                                |
| 12 Incorporation or retention of perennial species in pastures | The establishment or retention of existing native or sown introduced deep-rooted perennial grasses or legumes, as appropriate to soil type, in permanent or ley pastures for the purpose of maintaining feed and improving environmental management. |
| 13 Integrated pest management | Coordinated pest plant and animal control using a combination of chemical, cultural, biological and genetic control measures. |
| 14 Knowledge and skill development | Planning, acting, observing and reflecting on the farm enterprise that leads to continual adjustment, improving profitability and long-term sustainability. |
| 15 Management according to land capability | Land management based on whole farm planning, where various types of landscape are identified and managed according to the limitations or opportunities they offer. |
| 16 Managing for weather and climate variation | Environmental risk management to avoid operating losses and ensure opportunities are maximised from variable climate and weather. |
| 17 Nutrient budgeting | The maintenance or improvement of soil fertility based on soil and plant monitoring, budgeting of inputs and outputs and nutrient use efficiency. |
| 18 Occupational health and safety plan | The development and implementation of a plan to mitigate risks associated with farm machinery, agricultural chemicals, storage bins and exposure to dust and noise and so enhancing health and safety awareness of the farm family and workers. |
| 19 Quality assurance | Establishment and implementation of documented procedures that ensure food or product safety and quality. |
| 20 Retention and management of native vegetation | Preserving, protecting and maintaining the integrity of ecological functions and biodiversity in retained native vegetation. |
| 21 Soil conservation | The prevention of physical and chemical degradation of soil and the active rehabilitation or restoration of land degraded by salination, acidification, sodicity, erosion, waterlogging, hydrophobicity and vegetation loss. |
| 22 Tactical grazing | The development and implementation of specific grazing regimes to meet the needs of pasture, soil and stock. |
| 23 Tillage and stubble management | A cropping management system that minimises the impacts of vehicle traffic and cultivation on soil structure and biological health through avoiding or minimising tillage and retaining crop residues. |
| 24 Waterway and floodplain management | Protection of waterways and floodplains and maintenance of their natural function without further degradation. |
Figure 2 Dominant land use class, by gross value of agricultural production for statistical local areas in the Murray-Darling Basin
1. Agroforestry

Definition

Agroforestry is the management of trees and other woody perennials within agricultural systems for multiple environmental and economic benefits.

Description

Agroforestry may be carried out with trees in a number of configurations, including plantations, alley farming, shelterbelts, spaced plantings and management of remnant native forest on farms.

Plantations comprise distinct areas of merchantable tree species that may be used for sawn timber, pulpwood, firewood, posts and poles or other forest products, including non-wood products. Plantations are harvested periodically and require silvicultural management systems and harvesting plans.

Alley farming, shelter belts and spaced plantings are used in agricultural systems where crops or pasture are grown between (generally parallel) belts of trees or perennial shrubs (for example, Tagasaste – tree lucerne – a type of fodder shrub, and saltbush), along existing fence lines or between spaced trees. Agroforestry in this configuration may provide shelter for crops and livestock, forest products (for example, honey, seeds, foliage, timber, firewood, posts, pulpwood) or ecosystem services (for example, salinity control, water balance, wind control and water erosion control). It may be designed specifically for shelter, for convenience, to reduce cost or to maximise environmental services.

Native forest management parallels plantation management, except that the trees are in a natural or semi-natural setting. Trees are managed for various forest products, but may also provide secondary benefits including biodiversity conservation and other environmental services, as well as grazing. Management may include grazing, burning to manage fuel loads and thinning, pruning or harvesting.

Trees in some landscapes may be designed to maximise water use (for example, break of slope) or to affect salinity processes (for example, high potential recharge zones). Large scale afforestation may affect the catchment water yield, reduce stream flow and reduce total salt load (although seasonal concentration may be increased) and change the proportion of rainfall that infiltrates the soil profile.

Implementing the practice

* Thoroughly research options (seeking expert advice) before making investment in agroforestry.
* Understand market requirements of species, wood quality, processing, capital costs, changing land use costs, labour availability, integration with other crops and livestock.
* Develop a business and marketing plan to include harvesting plans, silvicultural management regimes, input and maintenance costs.
* Where the focus is on economic benefits, manage plantations as a monoculture and establish substantial areas (greater than 20 ha).
* In some landscapes, design plantations (combining location in landscape and configuration) to maximise access to water (for example, location at the break of slope) and/or their impact on salinity processes (for example, in preferential recharge zones).

Benefits of implementation

Agroforestry:

* diversifies the farm enterprise, improving resilience and providing an added income source;
* improves property values and repairs degraded landscapes;
* reduces groundwater recharge and risk of dryland salinity;
* reduces the threat of soil erosion (by water or wind) and improves water quality; and
* provides shade and shelter for stock and increases crop or pasture production.

Links to sustainability goals

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Further information


Virtual Consulting Group (1999) Farm Forestry Feasibility Study for North-Central and Wimmera Catchment Authority Areas and Buloke Shire. Department of Natural Resources and Environment, Bendigo.
2. Animal condition management

**Definition**

Animal condition management is a part of sound animal husbandry to ensure animal welfare, stock productivity and disease prevention to maintain stock for markets.

**Description**

This practice involves monitoring of stock for various parasites and disease agents to identify health issues and treatments before major intervention is required. Regularly checking animal condition, when linked with monitoring of pasture availability, supplementary feeding and general animal husbandry helps provide feedback on the effectiveness of the production system. The practice also includes risk management strategies to facilitate a strategic and effective response to parasite and disease outbreaks.

Monitoring of animal condition is an adaptive management process that helps to ensure efficient production and suitability of stock to meet market requirements.

**Implementing the practice**

* As part of the farm business plan, outline measures, input costs, monitoring and goals for maintaining animal condition.
* Develop and implement risk management strategies for prevention or treatment of parasites and diseases – vaccination and drenching through to quarantine and animal destruction in the case of highly contagious diseases (for example, Johne's disease) and address threats of infection, risks of cross infection, impacts of disease and efficacy of control measures.
* Keep record books for disease and parasite controls including use of chemicals.
* Regularly monitor for parasites and diseases (for example, flies, foot-rot, worms, ticks, lice, ovine and bovine Johne's disease, blast, grass tetany, staggers).
* Regularly monitor and record animal condition and weight in association with pasture quantity and quality and supplementary feeding rates.

* Provide shelter to protect stock from climatic conditions that diminish productivity.
* Include procedures for safe handling of disease control chemicals in occupational health and safety plan.
* Use external contract labour to assist with bulk animal handling.

**Benefits of implementation**

**Monitoring records and evaluation:**

* helps identify resistance to particular methods of parasite control, assess efficacy of drenching and chemical controls, and ensure appropriate and cost-effective control measures are implemented.

**Animal condition management:**

* ensures stock are healthy and more able to meet production and quality targets; and
* assists with general farm management, feed budgeting, planning and product marketing decisions.

**Risk management strategies:**

* may help prevent large scale disease outbreak, cross contamination of herds or flocks between properties and regions, and their social and economic consequences.

**Further information**


http://www.agric.nsw.gov.au
http://www.dpi.qld.gov.au
http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
http://www.pir.sa.gov.au

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3. Breeding program

Definition

A breeding program ensures that stock meet productivity and product quality targets, based on efficiency of breeding, feeding and animal health.

Description

Breeding programs are traditionally aimed at selecting progeny on the basis of characteristics which determine the market value of the end product (for example, weight for age, wool yield and micron). A breeding or bloodline strategy is developed to ensure that stock are fit for the purpose and not necessarily for premium markets only.

Implementing the practice

* Develop and implement a farm business plan incorporating goals and actions for breeding programs.
* Develop and implement a marketing plan to ensure results of program are consistent with market requirements.
* Develop a breeding program monitoring and benchmarking system to include input costs, operating costs as a proportion of income, monitoring and recording of animal condition statistics (feeding rates, weight gain and maintenance costs).
* Select breeds based on heritable traits, which reflect efficient feed conversion into the end product.
* Wool industry breeding generally targets production of the fine (less than 20 micron) wools that comprise the bulk of global demand.
* Beef and sheepmeat industry breeding targets specifications for carcase weight and fat depth. Specifications vary according to domestic or international market at which production is aimed.

Benefits of implementation

A breeding program:

* ensures stock are bred to suit local conditions and meet production and product quality targets;
* provides for better utilisation of available feed and greater stocking rates;
* reduces need for supplementary feeding;
* increases lambing and calving percentages;
* achieves higher market prices for niche breeds.

Benchmarking and the farm business plan:

* shows strengths and weaknesses of breeding goals; and
* highlights areas for improvement in performance; and opportunities for fine tuning the breeding program.

Further information


http://www.agric.nsw.gov.au
http://www.dpi.qld.gov.au
http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
http://www.pir.sa.gov.au

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4. Business and financial planning

Definition

Business and financial planning provides an operational framework for the farming enterprise that sets the boundaries within which investment in productive inputs and environmental management is made.

Description

The business and financial plan is a way of clearly defining family goals and business objectives and identifying the strategies and actions by which they might be achieved. It includes basic farm accounting practices such as annual budget and investment planning. It reviews the current situation of the farm business, its strengths and weaknesses and the opportunities and threats it faces. Monitoring of expenditure against the budget is required for the process to be effective, particularly in areas or enterprises where revenue forecasts can change rapidly.

Elements contributing to the business plan include market planning, enterprise diversification opportunities, farm business and environmental benchmarking, innovation and continuous improvement processes, risk management and succession planning.

Decision support tools may be used to assess financial risks due to uncertainty associated with factors such as climate. Experience and knowledge has traditionally guided on-farm decision-making, though more elaborate tools, ranging from graphs and decision trees to complex crop simulation models (for example, APSIM, WHOPPA, Grazfeed) and herd recording systems, are becoming widely available.

Farm business benchmarking is a way of monitoring farm business performance, highlighting where the business is strong and providing insight as to where performance can be improved. Common farm business benchmarking criteria include:

- farm cash surplus;
- disposable income;
- labour productivity;
- farm equity;
- rate of return on capital;
- operating costs as a proportion of income;
- off-farm income;
- debt to income ratio;
- crop yields or livestock production;
- farm profit (operating surplus after family labour and machinery depreciation);
- land productivity (operating surplus/land value);
- machinery productivity (machinery market value/income); and
- land capital per family member.

Environmental benchmarking may be used to provide a guide to the efficiency with which the production system is making use of natural resources, indicating trends in condition that may have long-term implications for production systems and investment decisions. Criteria include water use efficiency, soil health and fertility, groundcover, groundwater levels, and waste management and disposal. Monitoring also provides insight into natural processes that may be incorporated into farm management systems.

Innovation and continuous improvement represent actions where farmers seek new information and test different methods to suit their business objectives and goals. They build skills, knowledge and capacity to change and lead to consolidation of management practices into farming systems and farm business operation.

Continual fine-tuning in the following six areas of management also need to be undertaken in order to manage change and ensure a profit:

- optimum enterprise mix;
- optimum yields and production;
- cost efficiency;
- marketing;
- risk management; and
- operation control and timeliness.

Enterprise diversification involves diversifying the farm business to reduce the risks associated with production of single bulk commodities and issues of disease, pesticide resistance, climatic variability, and changing demand and market specifications. The production system should aim to produce at least some commodities which attract premium prices or for which the market outlook is more stable. Diversify through production of a combination of wool, sheep meat, beef or niche market commodities or services such as horticulture, timber and tourism.

Market planning involves understanding agricultural commodity prices and product specifications to guide
the cropping regime, fertiliser practice, breeding programs and lambing or calving times so that production reflects higher value niches within the market.

Risk management for farming enterprises is about developing and implementing effective, and sufficiently flexible strategies for coping with and reducing risks associated with climate variations (drought, frost, flooding), market variability, and workplace health and safety. Methods include income and general insurance, fixed interest rates and forward selling.

Future ownership is part of maintaining a family farming business. Succession planning needs to consider the three key areas of viability, management and ownership.

**Implementing the practice**

* Be prepared to repeat a cycle of planning, acting, observing and reflecting (learning) to continually improve and innovate.

* Apply decision support tools and models to assist with cropping and grazing decision-making.

* Obtain information from the internet, other farmers, Landcare groups, extension officers, journals and publications.

* Form cooperatives with local or compatible producers, or brand like products for higher value niche marketing.

* Regularly assess farm operations to ensure marketing is correctly targeted.

* Monitor consumer and trade attitudes and behaviour and market value, share and volume of particular commodities;

* Track seasonal rainfall predictions and use multiple species and varieties of pasture or crop.

**Benefits of implementation**

**Business and financial planning:**

* helps implement whole farm plan, prioritise on-farm investments, make best use of farm resources, set targets for expenditure, improve farm business returns and track progress in achieving them;

* helps consider off-farm investments such as shares and property;

* improves the business success of the farm and so the lifestyle of the operators;

* may improve the quality of decisions about crop selection and management practices resulting in more consistent grain yields and product prices;

* improves farmer insight into the factors that influence their production system;

* may improve the economic (or environmental) resilience and performance of the farm enterprise against adverse markets (commodity prices), climate or environmental variability;

* encourages production systems to target higher value markets;

* may reduce risk associated with production and marketing, reduce workplace injuries and improve profitability; and

* ensures efficient inter-generational transfer of property ownership, reduces uncertainty and stress associated with ownership transfer and prevents depletion of physical, financial and environmental capital of property during transfer process.

**Market plans:**

* may help the commodity production system meet market specifications, to take maximum advantage of favourable market or environmental conditions.

**Further information**


http://www.agric.nsw.gov.au
http://www.dpi.qld.gov.au
http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
http://www.pir.sa.gov.au
5. Chemical contamination avoidance

**Definition**
Chemical contamination avoidance is the appropriate use of agricultural chemicals to achieve the application’s purpose while avoiding contamination of soils, groundwater and surface water and impacts on non-target areas and species.

**Description**
The appropriate use and application of chemicals avoids contamination and takes into account the location of sensitive areas, climatic conditions, the type of chemical formulation and delivery methods. Pest management strategies, soil types and land classes, weather and climate variations, requirements for safe handling, storage and disposal are key factors to be considered in avoiding chemical contamination.

One of the main pathways for nutrients and pesticides to leave the farm and enter streams is via soil particles dislodged by surface run-off. The threat of chemical contamination via this pathway can be reduced by controlling erosion through maintaining higher levels of groundcover, minimum tillage and by on-farm water capture and storage (for example, tailwater dams). The whole farm plan should identify land classes and soil types to identify risk areas and avoid their contamination. Groundwater contamination may be avoided by careful use of chemicals (particularly those that are soluble or leachable) on light textured soils.

By carefully targeting chemicals, spraying during calm conditions and having shelter belts of trees in place as barriers for spray drift, damage to non-target species may be avoided. Use of less volatile formulations and delivery mechanisms that include larger droplet sizes, slower tractor speed and lower boom heights also reduce impacts on humans, livestock and the environment.

A pest management strategy should consider all practical methods for avoiding or managing pests, including non-chemical methods. It should describe the general approach being taken to the use of agricultural chemicals, such as not relying on one class of chemical for control of particular pests, and the seasonal use of different types of pesticides with their application methods and rates. The strategy should outline the major risk factors and how they will be managed, as well as procedures for avoiding environmental contamination, livestock resistance to pests and risks of elevated chemical residues.

Agricultural chemicals may also pose health risks to users if not handled appropriately and to farm workers or family members if not stored or disposed of safely. Relevant occupational health and safety procedures for the various classes of chemical must be followed.

**Implementing the practice**

- Develop a whole farm plan to understand and locate land classes and soil types at risk to contamination and manage chemical application accordingly.
- Develop an integrated pest management plan to optimise use of non-chemical control methods, and to administer correct dosages, avoid livestock resistance, contamination and residue build up.
- Develop an occupational health and safety plan to avoid potential hazards and risks of human contamination and procedures for safe use, handling and storage.
- Avoid spraying near sensitive areas including dams, streams, houses and native vegetation and under inappropriate climatic conditions.
- Use farm shelter belts to capture spray drift and avoid cross-boundary contamination and residues.
- Ensure there are sufficient groundcover and interception dams to prevent downstream contamination of waterways and wetlands.
- Appropriately locate and contain drenching and wash down areas to avoid groundwater and streams from becoming contaminated.
- Adopt sound waste management practices to ensure farm wastes (plastics, chemicals, packaging, biological wastes, and so on) are disposed of, re-used or recycled appropriately and do not cause contamination.

**Benefits of implementation**

Chemical contamination avoidance:

- maintains healthy humans, environments and farm enterprises;
- prevents impacts on non-target species, particularly remnant native vegetation and associated fauna;
- prevents contamination of soil, surface water supplies and groundwater;
- prevents exposure to chemicals that pose immediate or long-term health risks;
current recommended practice for broadacre dryland agriculture

- manages and prevents accidents involving chemicals and farm family members or farm workers;
- reduces health risks to farm family, workers and community;
- manages the development of resistance in target species;
- manages chemical residue build up in stock; and
- manages and reduces farm operating costs through appropriate application rates.

Further information


http://www.agric.nsw.gov.au
http://www.dpi.qld.gov.au
http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
http://www.pir.sa.gov.au

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6. Commitment to family

Definition

A commitment to family provides a lifestyle that balances workload with time for family, leisure, training and community.

Description

Long-term sustainability of a farm business requires that the farming family maintain a lifestyle that balances workload with time for family, leisure and recreation, vacations, training and community involvement. Achieving such a balance helps to maintain health, relationships, motivation and productivity.

Occupational health and safety planning, discussed in a separate section, is a way of ensuring individual farmers, farm families and farm workers maintain good health.

Commitment to family also involves succession planning, mentioned in business and financial planning.

Implementing the practice

* Develop and implement a farm business plan that includes time and costs for family, leisure and recreation activities and a succession plan for transfer of farm ownership.

* Develop and implement an occupational health and safety plan to ensure protection and prevention strategies are in place to avoid health risks, injuries and accidents, and maintain the health of family and workers.

* Regularly attend and participate in local community activities and social events to compare farming practices against those of peers, gain inspiration, affirmation, higher self-esteem and confidence.

Benefits of implementation

Commitment to family:

* maintains health and well-being of family;
* uses social and community support networks;
* improves motivation and productivity of workforce; and
* helps efficient inter-generational transfer of property ownership.

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Current Recommended Practice for Broadacre Dryland Agriculture
7. Community and industry participation

**Definition**

Community and industry participation is the practice of being involved in and participating in local community, environmental and agricultural industry activities.

**Description**

Involvement and participation in local community activities may involve general social activities and focused industry participation. Community groups may include Landcare, local government, catchment management and regional development organisations, school councils, and hospital, sporting, religious or service organisations.

Long-term sustainability of farming communities also depends, in part, on the commitment of business and government to maintaining essential services such as banks, health and education facilities, policing and emergency services, household and farming supplies in rural towns and cities.

Industry groups (for example, commodity councils and state farmer organisations) provide producers with a focus through which they may be able to influence their operating environment. These groups influence state and Commonwealth government natural resource policy processes and achieve concerted action with other producers.

Participation in industry activities may enhance capacity to adapt to change through cycles of planning, acting, observing and reflecting on the farm enterprise. Farmers seeking new information and testing different methods to suit their own business objectives and goals are more likely to achieve incremental change in management practices.

**Implementing the practice**

- Develop and implement a farm business plan, identifying learning and personal development needs, and identifying training providers through community and industry networks.
- Ensure plan is based around involvement in community and industry networks.
- Implement and act on plans; monitor and observe the results.
- Step back, reflect and learn, ask questions and develop new ideas.
- Incorporate continuous improvements in the farm business plan and marketing plan.
- Seek out relevant information from groups and participants.
- Balance time effectively with other needs, including farm work, family, training, skills and knowledge development.

**Benefits of implementation**

Community and industry participation:

- Provides a social support system for communities;
- Enhances opportunities for learning and personal development;
- Encourages cooperation within or between communities to achieve environmental, industry and community goals;
- Helps balance the lifestyle of farming families;
- Provides early access to market information, new technology and policy direction;
- Builds networks for information flow across regions and states;
- Influences the directions of the commercial and natural resource policy environments in which the farm business operates;
- Improves capacity, skills and knowledge to deal with change;
- Increases confidence in self and the farm business;
- Consolidates management practices into farming systems; and
- Helps develop tactics for land management in the face of changing climate or markets.

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8. Crop rotation

Definition
Crop rotation is the practice of seeking to maximise crop yield and financial return through rotating crops and pastures to help disease and weed control, efficient nutrient use and rates of water leakage and to respond to market and environmental opportunities and constraints.

Description
A management system that carefully and flexibly mixes crop types, including cereals, oilseed and legumes. Planning rotations should establish a series of principles about cropping sequences rather than develop a fixed rotation program.

Rotations must be managed in both time and space. Some crops cannot be sown in adjacent or nearby paddocks for several years after that same species (for example, canola). Inclusion of a disease break in the cropping rotation, combined with increased use of nitrogen-fixing crop species can significantly increase crop yields. For example, legumes or canola can boost soil nitrogen and act as a disease break for cereals. Inclusion of a ley pasture phase in long-term crop rotations can restore soil structure (and drainage), improve soil organic matter content and provide a disease and weed break. Use of a legume pasture in some parts of the Basin can also help build soil nitrogen levels for subsequent crops.

Nutrient management can be achieved by intercropping, whereby crops are sown into established perennial pasture (almost always lucerne). The pasture is suppressed at sowing by application of a knockdown herbicide at a relatively low rate. Under more moist conditions, lucerne intercropping may reduce the risk of waterlogging and so enhance grain yield. The crop also has the advantage of building up nitrogen fertility. Stock can graze the relatively high quality fodder during the summer following harvesting of the crop.

Use of lucerne as the ley pasture phase in cropping rotations can reduce groundwater recharge. A lucerne rotation of at least three years is usually required to empty the soil profile of water. Inclusion of a lucerne phase may provide protection against recharge for several years into the cropping phase of the rotation, depending on rainfall; spring removal of the lucerne may be needed to reduce any potential yield penalty from an over-dry soil profile.

Market and climate may create opportunities for double or opportunity cropping in some northern Basin cropping areas. The combination of summer and winter crops helps in disease and weed control, can assist with accumulation of soil carbon, reduce deep drainage and provide improved overall financial returns.

Opportunity cropping involves the sowing of a summer or winter crop in response to favourable rainfall or soil water availability. The use of such triggers for sowing should maximise long-term financial returns from cropping and ensure the soil profile does not remain full of water and at risk of deep drainage and groundwater recharge.

Mixed enterprises can smoothly transfer between cropping and grazing by undersowing perennial and annual pastures (except perennial summer grasses) in the final crop of a rotation. Alternate row sowing is one means recommended for this, as it allows both crop and pasture to be sown at appropriate depths and with the required fertiliser. It may also reduce early competition between the two and increase the likelihood of successful pasture establishment. It also means that land is not unproductive during pasture establishment.

Implementing the practice

* Establish cropping sequence principles as part of the farm business plan to achieve multiple objectives around soil health, nutrient management, enterprise mix, and opportunities for responding to market and environmental conditions.

* Understand groundwater, salinity, water balance processes, soil types and land management units through the whole farm plan. Manage cropping areas and crop rotations to match land capability. Practise opportunity cropping or perennial pasture ley phase in areas where watertable recharge is a concern.

* Regularly monitor and review climate forecasts to plan for crop rotations and timing of sowing.

* Regularly benchmark, monitor and review crop yields, livestock production, soil health and moisture properties, labour productivity, machinery and operating costs to ensure continuous improvement in the management of crop rotation.

* Manage pastures to encourage water use by allowing deep root systems to develop and perennials to be maintained.

* Incorporate perennial vegetation into cropping systems – as a pasture phase in crop rotation or through intercropping.
Benefits of implementation

Crop rotation:
* reduces risk of weeds, pests or disease infestations;
* improves soil structure and fertility, providing nitrogen for subsequent crops;
* increases yields, long-term cropping success and financial returns;
* maintains flexibility and resilience in the production system and improves farm diversification;
* reduces long-term rates of deep drainage and recharge, and
* encourages a management system that is responsive to market requirements.

Lucerne in the key phase of crop rotation:
* helps to reduce groundwater recharge and salinity risk, and ensures productive use of rainfall and nutrients.

Intercropping:
* allows almost seamless transition between cropping and pasture phases of rotation.

Undersowing:
* may provide cost-efficient transfer from crop to pasture phases, particularly in mixed farming enterprises.

Further information


http://www.grdc.com.au
http://www.agric.nsw.gov.au
http://www.dpi.qld.gov.au
http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
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9. Effective management of labour and resources

Definition

Effective management of labour and resources involves the strategic use of supplementary labour, specialist consultants or contractors to ensure timeliness and quality of farm and farm business operations.

Description

Timeliness is important in many agricultural activities. Short, intensive periods of activity (for example, harvest, lambing, weed control) may necessitate external assistance. Recognising on-farm limitations in skill, time and equipment may suggest that improved efficiency can be achieved through the use of advisers or contractors.

Recommended practice is to make use of a flexible workforce and contract labour (for example, for mustering, shearing, lamb marking) and utilise specialists and their machinery (for example, shearing, harvesting, spraying, planting and agronomic advisers) when available. Use of contractors or additional labour will help meet peak demands without the issues and cost of employing additional staff and stresses in the farming family associated with unbalanced workload. Contracting services will be most effective particularly where a farming operation is not of a sufficient scale to maintain specialised or very expensive machinery. The use of contractors may not be best practice in areas of operation in which there is only a small market for the particular service. In such cases, reliance on contractors may be expensive and not timely and contrary to the efficient management and profitability of the farm.

A professional approach to labour management is required, including labour recruitment, induction and operational rules, health and safety guidelines and training. Through understanding profit and decision-making processes, employees are encouraged to be more self-reliant and productive.

Maintaining farm equipment in good working order is essential to increase efficiency, and decrease long-term maintenance costs. Employing energy-efficient technologies and measures will not only reduce costs but may also reduce greenhouse gas emissions.

Whole farm planning that considers a system of laneways, internal access and distributed stockyards can contribute to improved productivity. It simplifies movement of livestock and machinery, improves vehicle access and provides fire breaks. Laneways may also incorporate a shelterbelt system to protect crops and stock from wind. Linkage with stockyards and shearing sheds improves efficiency of stock handling and movement.

Government cost-sharing or incentive schemes (including the provision of labour) for funding such activities as laying fox baits, weed spraying (for example, blackberry), revegetation, fencing and replanting riparian zones and installing groundwater monitoring bores may reduce the direct costs to the landholder or the activities that would otherwise need to be undertaken.

Implementing the practice

* Through the farm business plan, identify needs and timing for contract labour, external specialists and machinery.
* Develop an energy management plan that includes the way the farm business uses energy and makes the most use of current equipment.
* Consider the design, maintenance and energy efficiency of machinery and farm infrastructure prior to purchase or during farm redevelopment. Include energy smart equipment, alternate or renewable energy, watering troughs, windmills, pumps, fences, yards and sheds.
* Ensure machinery and farm equipment is maintained in good working condition.
* Employ practices that require less use of machinery, for example, conservation cropping – zero tillage and controlled traffic.

Benefits of implementation

Effective management of labour and resources:

* improves timeliness of farming operations;
* balances workload and improves lifestyle;
* avoids capital expenditure on plant that cannot be sustained by the farm business;
* reduces energy and long-term maintenance costs and increases profit;
* increases labour and machinery efficiency;
* reduces greenhouse gas emissions; and
* reduces contamination or dirtying of wool from dust.
Whole farm planning:

* improves productivity;

* improves access within properties and provide fire breaks; and

* reduces erosion risk associated with unformed tracks in paddocks.

Further information


http://www.agric.nsw.gov.au
http://www.dipn.nsw.gov.au
http://www.dpl.qld.gov.au
http://www.dpi.qld.gov.au
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Agroforestry
Animal condition management
Breeding program
Business and financial planning
Chemical contamination avoidance
Commitment to family
Community and industry participation
Crop rotation

Effective management of labour and resources

Environmental monitoring and benchmarking
Identification and protective management of cultural heritage
Incorporation or retention of perennial species in pastures
Integrated pest management
Knowledge and skill development
Management according to land capability
Managing for weather and climate variation
Nutrient budgeting
Occupational health and safety plan
Quality assurance
Retention and management of native vegetation
Soil conservation
Tactical grazing
Tillage and stubble management
Waterway and floodplain management
10. Environmental monitoring and benchmarking

Definition

Environmental monitoring and benchmarking is a practice of strategic monitoring to provide information on natural resource (soil, water and vegetation) condition and trend, which underpins adaptive management systems and performance benchmarking for the agricultural production system.

Description

Environmental monitoring may address climate, energy efficiency, native flora and fauna, weeds and pest animals, soil condition, water quality and watertable depth. Attributes monitored and the formality of monitoring would depend upon the environmental management issues in particular landscapes and whether monitoring data is reported to broader monitoring programs (for example, for water quality, watertable depth). Monitoring of rainfall and climate and keeping abreast of seasonal forecasts can assist decision-making on crop choice, sowing time, stocking rates, and fertilizer applications.

Environmental benchmarking may be used to provide a guide to the efficiency with which the production system is making use of natural resources.

Implementing the practice

* Develop and implement a farm business plan; include a section on the enterprise monitoring and benchmarking data collection requirements.

* Regularly monitor and review climate forecasts to include in environmental monitoring and benchmarking.

* Determine water use efficiency in terms of dry sheep equivalent/ha/mm annual rainfall or grain yield per mm of growing season rainfall. These provide an indication of the efficiency with which rain is converted to marketable commodities.

* Monitor soil structure and biological health to assess implications for productivity and need for changed management or remedial actions.

* Monitor groundwater for understanding of salinity processes and early detection of threats to productive capacity.

Benefits of implementation

Environmental monitoring and benchmarking:

* avoid costly remediation and rehabilitation by identifying negative trends early, when changes in management practice may be all that is required;

* provide information and understanding about the condition and trend in the natural resource base upon which the production system depends;

* may provide early warning of threats (such as drought) and help to reduce costs of mitigation;

* may inform farm planning and investment decisions for productive and environmental management activities;

* reassure markets of quality assurance and of clean and green products, which may assist market access; and

* inform and respond to catchment-scale natural resource management planning and initiatives.
Further information


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11. Identification and protective management of cultural heritage

Definition
The practice of identifying cultural heritage issues associated with sites and places, assessment of heritage significance, and development and implementation of a management strategy for maintenance of cultural values.

Description
Cultural heritage comprises the places, objects, events, cultural practices, stories, records and intangible values which reflect Australia’s biophysical diversity and its cultural diversity – indigenous and non-indigenous. Indigenous heritage is intimately linked with the landscape, beliefs and customs. It includes those cultural landscapes and places, intellectual property, knowledge, skeletal remains, artefacts, beliefs, customs, practices and languages that are important to Australia’s indigenous people. Non-indigenous cultural heritage concerns itself with human culture, for example buildings, agricultural and household implements, landscapes modified by people and the traditions of small rural communities.

By participating in the activity of farming, farmers are contributing to the development of farming culture and subcultures. This process of transforming farming culture is reflected and recorded in agricultural landscapes. Agricultural landscapes are therefore cultural landscapes. Large-scale land use changes that have significant impact on the look and feel of the local landscape can dramatically disrupt this process of cultural transformation. This can have negative and positive implications in influencing land use change.

Decisions affecting most heritage places are carried out under state and local government environment, heritage and planning laws. Listing in the Register of National Estate gives heritage places some protection through obligations of Commonwealth agencies under the Australian Heritage Commission Act 1975. The Australia ICOMOS Burra Charter 1999 sets a standard of practice for those who provide advice, make decisions about or undertake works on places of cultural significance, including owners, managers and custodians. It provides guidance for the conservation and management of places of cultural significance. The draft document ‘Respecting Indigenous Heritage Places: A practical guide’ has been developed to assist developers, researchers, cultural heritage professionals and other land users who have to deal with issues relating to the identification, management and use of indigenous heritage places.

Implementing the practice
* Identify a potential cultural heritage issue – recognising that a place, object, landscape or artefact may contain cultural heritage values.
* Report on potential cultural heritage issues – to relevant government authorities and local community groups (including indigenous groups) that have an interest in cultural heritage.
* Assess the significance of cultural heritage issues with professional heritage practitioners, in consultation with relevant stakeholders (for example, landowner, indigenous or community groups, local government). The assessment should result in a statement of cultural significance that is supported by sufficient graphic material to help identify the elements of cultural significance and it should identify obligations arising from that significance. The assessment is an essential prerequisite to the development of a conservation policy and management strategy.
* Develop a conservation policy – the purpose of a conservation policy is to state how the conservation of the cultural heritage issue may be best achieved in the short and long-term and integrated into the whole farm plan. A conservation policy is specific to a heritage issue.
* Develop and implement a cultural heritage management strategy – following the preparation of the conservation policy a management strategy should be developed that outlines how the cultural heritage issue will be conserved, maintained, preserved, or restored. It may consider issues such as co-existence, financial resources and cost-sharing arrangements, technical staff and physical management of the issue.

Benefits of implementation
Identification and protective management of cultural heritage:
* recognises a sense of connection to community and landscape, to the past and to lived experiences;
* preserves historical (and prehistorical) records that are important expressions of Australian identity and diversity;
* brings economic benefit through properly resourced, managed and marketed recreation and tourism; and
* facilitates appropriate pricing of natural and cultural resource capital that is fundamental to realistic cost-sharing for on-ground actions.
Further information


NSW Agriculture (undated) Conserving our Farming History. CB Alexander Agricultural College, Tocal.

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Agroforestry

Animal condition management

Breeding program

Business and financial planning

Chemical contamination avoidance

Commitment to family

Community and industry participation

Crop rotation

Effective management of labour and resources

Environmental monitoring and benchmarking

Identification and protective management of cultural heritage

Incorporation or retention of perennial species in pastures

Integrated pest management

Knowledge and skill development

Management according to land capability

Managing for weather and climate variation

Nutrient budgeting

Occupational health and safety plan

Quality assurance

Retention and management of native vegetation

Soil conservation

Tactical grazing

Tillage and stubble management

Waterway and floodplain management
12. Incorporation or retention of perennial species in pastures

Definition
Establish or retain existing native, or sown introduced, deep-rooted perennial grasses or legumes, as appropriate to soil type, in permanent or ley pastures for the purpose of maintaining feed and improving environmental management.

Description
The longer growing season of perennial pasture plants helps to reduce the period of feed deficit and allows a better match of feed availability with demand. Sown perennial pastures generally include legumes, which help to improve forage quality. They are often relatively well fertilised and more productive than unsown pastures. The more summer-active perennials make productive use of summer rainfall and further reduce gaps in feed supply.

The longer growing season and deeper roots of perennial pastures may allow them to use more water than annual pastures and may be important in reducing leakage from some landscapes, aiding water balance management. This may reduce the risk or salinity and slow the rate of soil acidification. Perennials may be used as permanent pastures or a ley phase within a cropping rotation.

Maintaining summer groundcover can help to prevent soil erosion and subsequent invasion by annual weeds. Increased surface roughness under perennial pastures helps to reduce run-off and the risk of flooding and flood-induced groundwater recharge in low lying areas. Strips of perennial pasture along streams may filter sediment from overland flow and so reduce nutrient transport to streams. Well-grassed areas in floodplains, particularly in areas prone to fast flows, will help to reduce gullying and scour in flood events.

If appropriately managed, fodder conservation in rangeland areas may reduce the loss of groundcover or damage to perennial plants by grazing at times of low production and may improve the resilience of an enterprise in the face of drought.

Implementing the practice
* Develop and implement a whole farm plan that outlines land capability classes for optimal pasture, feed and stock or crop productivity.

* Manage pastures to encourage water use by tactical grazing that includes spelling to allow leaf area to accumulate, to allow deep root systems to develop and to maintain perennials in the pasture sward.

* Include perennial vegetation into cropping systems as pasture phase in crop rotation, through intercropping or a perennial ley pasture phase.

* Monitor the quantity and quality of fodder available and budget its consumption as an important tool to achieve a match between the demand and supply of feed to stock.

* Through pasture monitoring, determine the amount of feed in the paddock (for example, using key pasture species height, herbage mass, groundcover, basal cover), its quality (digestibility, protein) and its composition (ratio of desirable to undesirable species).

* Adjust lambing or calving time to improve the match between feed availability and demand.

Benefits of implementation
Incorporation or retention of perennial species in pastures:

* increases amount of feed available, possibly at times where green feed would otherwise be in short supply;

* helps maintain groundcover, protect against erosion, reduce run-off and maintain water quality downstream;

* helps maximise rainfall use and reduce deep drainage, recharge and rates of soil acidification, and prevent rising watertables and salinisation; and

* develops producer skills in identifying grasses, understanding their requirements and management.

Lucerne ley pastures:

* can improve soil fertility, provide nitrogen for subsequent crops and improve soil structure.
Further information


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13. Integrated pest management

Definition
Integrated pest management is a practice of coordinated pest plant and animal control using a combination of chemical, cultural, biological and genetic control measures.

Description
Integrated pest management is a coordinated approach to pest plant and animal control which uses multiple control measures: cultural (cultivation, habitat destruction, burning, grazing management, fertiliser application), chemical, biological and genetic. Pest management strategies are specific to the pest profile and farm management system. Management and control programs include monitoring of pest populations and investigating the efficacy of control measures.

Inappropriate chemical use can lead to the development of resistance in target species (insect, weed, disease agent), reduce the efficacy and increase the cost and complexity of control measures. Herbicide resistance is a less important issue in summer rainfall areas, where the rotation between summer and winter crops helps with crop weed control.

Pasture cleaning combines grazing management and herbicide use and aims to remove undesirable pasture species. Low rates of herbicide may be used to improve palatability and relatively high stocking rates applied to maximise utilisation. Pasture cleaning should be deployed strategically, as it is most effective when a clear build-up of pasture weeds is evident.

After control, pasture weeds need to be replaced by encouraging vigorous swards of desirable species through good grazing management and maintenance of soil fertility.

In rangeland areas, management of fauna and pest animal populations may be required to reduce total grazing pressure to an acceptable level. A combination of shooting, trapping, chemical and biological control (for rabbits) may be used. This should help maintain groundcover and reduce erosion risk. It may also help prevent overgrazing and the inherent threat this poses to biodiversity in native vegetation subject to grazing.

Some native fauna populations have increased beyond their natural levels due to better access to feed and water with agricultural or pastoral development. Controlling access to water may help to provide longer term reduction in populations in drier areas. Destruction of fauna is generally subject to a permit from appropriate state natural resource management agencies. In agricultural areas, management of native fauna and vertebrate pests needs to be coordinated across districts to reduce opportunities for populations to recover by migration.

Implementing the practice

* Develop and implement a pest management strategy incorporating a diversity of management and control measures; this should be linked with strategies for the careful use of agricultural chemicals.
* Identify needs for external contract labour to assist with pest investigations and control activities in the farm business plan (for example, spraying, pest identification, harbour destruction).
* Ensure the farm occupational health and safety plan includes safety procedures for correct handling, storage and application of chemical control agents.
* Understand the pest life cycle to ensure methods target the most vulnerable growth stage.
* Rotate the use of all pesticides, use different chemical groups to reduce selection pressure in the target species for resistance to a particular group.
* Apply techniques, combining cultural, chemical and, if available, biological controls to reduce selection pressure that would reduce the effectiveness of any particular measure.
* Prevent reinestation by weeds through establishment and maintenance of vigorous cover of desirable crop or pasture species.
* Plan and implement management and control measures across property boundaries.
* Undertake regular monitoring, benchmarking and maintenance activities to ensure that, once controlled, pest populations remain at low levels.

Benefits of implementation

Integrated pest management:

* reduces the impact of pest plants or animals on stocking rates or carrying capacity;
* reduces reliance on pesticides and the risk of resistance developing in pest populations;
* reduces the risk of chemical residue contamination in products; and
* provides improvements in biodiversity in on-farm and grazed native vegetation;
* improves pasture composition, reduces weed competition and improves production of more desirable species;

* improves groundcover, particularly during drought, and reduces erosion risk;

* reduces total grazing pressure;

* allows for some increase in stocking rate; and

* reduces time and financial expenditure on pest control.

Further information

http://www.crc.org.au
http://www.agric.nsw.gov.au
http://www.dpi.qld.gov.au
http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
http://www.pir.sa.gov.au
http://www.grdc.com.au

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Integrated pest management

Knowledge and skill development

Management according to land capability

Managing for weather and climate variation

Nutrient budgeting

Occupational health and safety plan

Quality assurance

Retention and management of native vegetation

Soil conservation

Tactical grazing

Tillage and stubble management

Waterway and floodplain management
14. Knowledge and skill development

Definition

Knowledge and skill development is the practice of planning, acting, observing and reflecting on the farm enterprise that leads to continual adjustment, improving profitability and long-term sustainability.

Description

The ability to rapidly adjust to change is important for farm enterprises to be sustainable. Many programs are available that offer training in business and production components of the farm enterprise and more general health and well-being issues for the producers themselves. They exist at two main levels:

* accredited agricultural or business training – through universities or TAFE institutes – which provide course participants with transferable skills and knowledge and recognised formal qualifications; and

* joint learning activities – (for example, Prograze, TopCrop, FM-500, Farm$mart, field days, seminars) – which encourage technology transfer from professional specialists and sharing of local information and experience among primary producers through participatory action learning.

Innovative management requires a positive attitude towards change and is needed to encourage thinking beyond normal paradigms and to examine innovations and new ways of making a profit. No amount of budgeting or production advice will allow a farm to achieve long-term sustainability where the manager does not take a positive approach to change and adoption of innovative practices.

Producer organisations, primary industry research and development corporations and government agencies all run research and development projects which include producers as partners. Producer participation in research and development encourages researchers to consider their clients’ real information needs and the practical constraints posed by primary producers’ operating environments.

Producers may initiate their own research and development activities to improve production systems or environmental management. They may also conduct research to improve confidence with new technology before widely adopting it across their property.

Implementing the practice

* Develop local advice networks with producer organisations, researchers, extension providers and peers.

* Seek out information from the internet, peers, local Landcare and environment groups, extension officers, journals and publications.

* Identify in the farm business plan areas for improving farm operation and appropriate training providers.

* Regularly attend local field days and best practice forums.

* Balance knowledge and skill development with work and family time.

Benefits of implementation

Knowledge and skill development:

* improves primary producer skills and expertise;

* addresses the real information needs of producers;

* facilitates technology and knowledge transfer and improves technical networks;

* reduces risks associated with adoption of inappropriate technology;

* enhances sense of ownership of research goals, leading to increased probability of adoption;

* improves production systems and environmental management;

* improves responsiveness of producer to change (in technology, markets, environment) and resilience of farm enterprise;

* improves opportunities for producer to benchmark their enterprise; and

* improves management of farm enterprise from environmental, production system and business perspectives.

Knowledge and skill development
Further information


http://www.agric.nsw.gov.au
http://www.dpi.qld.gov.au
http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
http://www.pir.sa.gov.au

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Links to sustainability goals:

- Cultural heritage
- Financial return
- Greenhouse and air quality
- Nature conservation
- Quality of life
- Soil health
- Water quality and quantity
15. Management according to land capability

Definition

Management according to land capability is a practice of land management based on whole farm planning, where various types of landscape are identified and managed according to the limitations or opportunities they offer.

Description

Whole farm planning identifies landscape units and encourages landholders to match the use or management of land within the limitations and opportunities presented by such factors as soils, landform, vegetation, biodiversity, existing land degradation, fauna, pests and climate. It applies to grazing and cropping.

Land class fencing is most relevant in grazing or pastoral operations, where it provides the opportunity to control the timing, duration and intensity of grazing and better match grazing with fodder availability, trafficability and the spelling or grazing needs of the pasture.

Precision farming and yield mapping allows specific areas within paddocks to be managed differently, based on productive capacity and other land capability criteria. This technique uses global positioning technology, a yield monitor and geographic information systems to measure and map crop or pasture yields across paddocks and farms. This provides improved insight into paddock performance and allows inputs (especially fertiliser and seed) to be targeted to the areas of greatest need or responsiveness. It also allows unproductive areas to be identified and, if appropriate, to be excluded from cropping. Precision farming technology is expensive and only likely to be adopted in large-scale intensive cropping operations, rather than in mixed farming regions. Precision farming techniques are designed to improve the efficiency of inputs, improve nutrient budgeting and increase paddock yields.

Reticulated water supply is useful in several landscape contexts. Direct watering of stock from streams is frequently associated with bank degradation and poor water quality. The provision of off-stream reticulated water can allow riparian fencing, which in turn can eliminate the damage associated with uncontrolled grazing along waterways.

In rangeland areas, particularly those dependent on artesian or sub-artesian bores for water supply, construction of a reticulated water supply can avoid the huge water losses associated with open channel supply systems. This helps to conserve the water resource and can limit water availability for native fauna and lead to long-term reductions in populations.

Contour banks may be used for erosion control in some environments. They are introduced to reduce the length of slope, slow overland flow and reduce sediment entrainment during rain. By reducing overland flow and sediment transport, they help to prevent gully and sheet erosion and reduce silt deposition in streams and in lower slope positions. In some hydrogeological settings, (poorly constructed) contour banks may aggravate salinity by encouraging water ponding and increasing groundwater recharge.

Implementing the practice

* Develop and implement a farm plan that recognises catchment and regional perspectives and identifies different land classes. The plan should be based on slope and slope length; soil type, depth, water holding capacity; nutritional status and other limitations (for example, sodicity, salinity); flood risk; presence, type and conservation status of native vegetation; and salinity hazard. The plan should provide for appropriate and (as necessary) separate management of each land class.
* Monitor and review the farm plan with robust environmental and business benchmarking.
* On northern floodplain areas, develop a strip cropping layout across the property and link with layouts of adjoining landholders.
* Fence to land class in grazing operations or areas.
* Ensure that inputs match the productive capacity of the land and concentrate development activities on those areas from which returns are likely to be greatest.
* Indicate how and where actions will be taken to achieve the desired goals for the property.
* Site farm forestry plantations and revegetation in areas appropriate for water balance, shelter, productivity, timber utilisation and linkage with native vegetation remnants.
* Use specialised fencing designs in some areas, such as riparian zones that are subject to flooding.
* Provide reticulated watering systems as required by farm layout.
* Match stocking to fodder availability to improve utilisation.

Benefits of implementation
Management according to land capability:
* encourages more sustainable land use and reduces environmental degradation;
* improves efficiency of resource use by identifying areas of greatest return and need;
* extends capacity of land manager or producer to understand how their landscapes work and how to respond to the various land management challenges and opportunities those landscapes pose;
* provides a framework of priorities for productive activities and environmental management;
* allows for sensitive areas to be rehabilitated and protected from uncontrolled grazing and its impacts;
* improves land condition, pasture composition, land cover and biodiversity and helps reduce soil erosion and pasture decline; and
* provides improved water quality in streams and for watering stock.

Further information


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Management according to land capability
Managing for weather and climate variation
Nutrient budgeting
Occupational health and safety plan
Quality assurance
Retention and management of native vegetation
Soil conservation
Tactical grazing
Tillage and stubble management
Waterway and floodplain management
16. Managing for weather and climate variation

Definition

Environmental risk management to avoid operating losses and ensure opportunities are maximised from variable climate and weather.

Description

Climatic variability is a feature of most environments in the Basin. Farm planning must incorporate defined tactics to deal with extreme wet and dry seasons. Management for weather and climate risk can be achieved by enterprise diversification, well-planned robust farming systems and adaptive management practices that can adjust farm operations according to the season.

The relative importance of each individual weather or climate risk (for example, drought, floods, waterlogging, hail, frost) must be assessed, as there may be trade-offs in yield or production or timeliness of operations. Ill-considered responses to recent climatic events may result in losses from other, more significant risk factors.

One of the most important aspects of managing for climate variability is to run a profitable business which allows for the setting aside of financial reserves to cope with climatic extremes, such as drought. Developing off-farm income sources (property or shares) should be considered.

Drought is the most significant climate risk in the Basin. Difficulties encountered in the early recognition of drought conditions can be offset by the development of triggers or benchmarks that determine when decisions or preventative actions should occur. Decision-making on drought strategies for livestock will vary between properties and seasons and will also depend on market prices for stock and costs of feed and agistment. Triggers might be related to climate (for example, monthly rainfall), resource condition (for example, water supply levels, fodder availability) or farming practices (for example, amount of additional feed required).

A drought strategy would include consideration of:

* destocking, feedlotting and agistment;
* feed budgeting including fodder conservation and supplementary feeding;
* monitoring of water supply;
* sowing and cultural (weed control, fertilisation) tactics to deal with risk of failure of seasonal rains and poor rainfall outlook;
* long-term financial management strategies to deal with income variability;
* deferment of machinery and other capital purchases; and
* crop insurance and enterprise diversification.

Risks to crops from frost, hail and damage by heat waves can be mitigated, in some settings, by multiple sowing and maturing times, variety selection and not consolidating holdings into single contiguous blocks.

Implementing the practice

* Prepare a drought strategy that includes climate, resource conditions or farming practice-related triggers for management change.
* Put feedlot stock on more stable paddocks and provide maintenance feed during drought. Adjust stocking rates.
* Move stock to better drained paddocks from those likely to be waterlogged (and vulnerable to pugging) during very wet periods.
* Use seasonal forecasts and information on existing soil moisture to aid decision-making on crop choice, fertiliser application, planting time options and varieties with different maturity times.
* Choose crops species or varieties that are more tolerant of the prevailing climatic risk factors.
* Diversify crops, farmed areas, planting and harvesting times to avoid risks associated with frost, hail or heat waves at key points in crop growth cycle.
* Use zero or minimum tillage and opportunity cropping (in northern Basin cropping areas) to make maximum productive use of rainfall.
* Carry insurance against weather damage.
* Source additional labour or equipment to ensure timeliness of operations.
* Utilise decision support models such as Rainman, Wheatman and Howwet.
* Seek information about weather forecasts and other weather information services.
Benefits of implementation

Managing for weather and climate variation:

* improves farm planning, risk management and resilience of farm enterprises;
* helps producers make better use of seasonal opportunities;
* reduces adverse environmental impacts of extreme climatic conditions;
* reduces costs of rebuilding the production system (flock or herd, soil structure) following an extreme climatic event;
* reduces financial and personal stresses during and following such events;
* ensures productive use of rainfall;
* results in relatively low, long-term rates of deep drainage and recharge; and
* maintains the natural resource base upon which long-term production depends;
* improves the efficiency of watering and feeding during drought;
* helps maintain groundcover, reduce erosion risk and reduce weed colonisation; and
* helps protect water quality by reducing soil loss during extreme rainfall events or with the break of a drought.

Further information


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Managing for weather and climate variation

Nutrient budgeting

Occupational health and safety plan

Quality assurance

Retention and management of native vegetation

Soil conservation

Tactical grazing

Tillage and stubble management

Waterway and floodplain management
17. Nutrient budgeting

Definition

Nutrient budgeting is the practice of maintaining or improving soil fertility based on soil and plant monitoring, budgeting of inputs and outputs and nutrient use efficiency.

Description

The efficient use of nutrients is essential to farm productivity. Nutrient (nitrogen, phosphorus, zinc) budgeting is based on understanding the responsiveness of soils to fertilisers (through soil and crop monitoring) and matching nutrient inputs to outputs. Nutrient exports must at least be matched by inputs to maintain productive capacity. Nutrient budgeting may also take yield expectation and rainfall probability into consideration.

Without maintenance applications of fertiliser, the removal of nutrients with animal products (and their redistribution around and between paddocks) would result in a progressive decline in soil fertility. This may result in loss of desirable species (clovers, perennials) and decline in pasture production. Similarly, the removal of nutrients with grain or hay (and stubble if burnt or grazed) would result in a progressive decline in soil fertility and grain yield without balancing nutrient inputs.

Fertiliser application should be matched to crop or pasture requirements, nutrient export in products and wastes and soil response. It should be carried out in response to soil and (for nitrogen) plant tissue monitoring. Fertiliser applications should be used in combination with appropriate grazing tactics to utilise additional feed produced. Large (capital) fertiliser applications (generally of phosphorus) may be applied to responsive soils to quickly improve pasture growth and stocking rate. In some production systems they may achieve a greater response than incremental improvements in soil fertility.

Legumes are used in crop rotations to reduce nitrogenous fertiliser requirements. In mixed farming areas, legume pastures are used to help build up soil nitrogen concentrations for use during the cropping phase. Legumes in mixed pastures provide much of the nitrogen in feed and largely drive animal production.

Sowing crops and pastures with lime, and top dressing good quality, well-established pastures may boost nutrient response, productivity and, in some cases, plant water use. It should help sensitive crop and pasture species establish on sites with acidic topsoils. Lime application may assist persistence of sensitive perennial pasture species, particularly where pH does not decline with depth.

Soil and animal tissue testing may be used to identify trace element deficiencies. These are addressed through additions of trace elements to fertiliser mixes or by direct feeding of supplements.

Implementing the practice

* Develop and implement environmental monitoring and benchmarking of soil fertility and pH.
* Through the whole farm plan, develop an understanding of land capability and soil types as they link to nutrient application rates.
* Understand crop and pasture requirements for nutrients and budget accordingly.
* Include legumes in pastures to build soil fertility and provide nitrogen for livestock.
* Include legumes in crop rotations to maintain soil nitrogen fertility and reduce fertiliser requirements.

Benefits of implementation

Nutrient budgeting:
* maintains or improves soil fertility and pasture or crop growth;
* may help maintain desirable pasture composition, groundcover and water balance;
* may help maintain or increase stocking rates and animal production;
* helps maintain soil pH and fertility within acceptable levels; and
* improves the persistence of sensitive perennial species.

Use of legumes:
* builds soil fertility and reduces nitrogen fertiliser use and associated expense and energy expenditure.
Further information


http://www.agric.nsw.gov.au
http://www.dpi.qld.gov.au
http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
http://www.pir.sa.gov.au
http://www.bettersoils.com.au

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18. Occupational health and safety plan

Definition

Development and implementation of a plan to mitigate risks associated with farm machinery, agricultural chemicals, storage bins and exposure to dust and noise and so enhancing health and safety awareness of the farm family and workers.

Description

An occupational health and safety plan describes ways to maintain the health and increase the safety awareness of people working in agriculture. Responsibility for farm safety rests with individual farmers, farm families and farm workers. All employees should be in good health, have adequate rest, understand potential risks and hazards, and be adequately trained and resourced.

Implementing the practice

* Develop and implement a farm occupational health and safety plan outlining guidelines, induction and operating rules for all areas of the enterprise.
* Fit a roll-over protection structure to tractors to prevent death and serious injury from roll-over. Tractors and machinery (headers, augers, silos, shearing machines) are leading causes of death and injury on Australian farms. Other important forms of protection include protective guards, dust extractors and electricity safety switches.
* Use noise controls supplied with machinery, use hearing protectors and reduce exposure to loud noises. Excessive noise can induce hearing loss.
* Avoid hazardous activities near overhead powerlines, ensure proper maintenance of electrical equipment, wear appropriate footwear when using electric tools and only use certified tradespeople for electrical work.
* Prevent back injury by using the correct methods of lifting, carrying, bending, pushing and reaching; exercise regularly for strength and flexibility; and use appropriate mechanical aids.
* Handle, store and dispose of agricultural chemicals appropriately. Chemical users should undergo training in safe usage; read and follow label instructions; use protective clothing, masks and respirators (as necessary); use less toxic chemicals wherever feasible; safely dispose of excess chemical and chemical drums (for example, through programs such as DrumMuster). Time lags are required between chemical application and shearing to reduce residues in wool that may affect shearers, wool classifiers and shed workers.
* Manage stress by having regular rest (including holidays); improving planning and time management skills; sharing workloads; improving the physical working environment; providing suitable training; maintaining a good diet; taking regular exercise; using contractors or casual labour during periods of high labour demand.
* Wear clothing that provides protection from the sun, apply sunscreen and wear sunglasses. Solar radiation can cause skin cancer and damage eyes.

Benefits of implementation

An occupational health and safety plan:

* improves health and well-being of employees and family and productivity of agriculture;
* encourages a more productive workforce;
* reduces incidence of workplace accident, injury or illness and risk of related litigation; and
* prevents exposure to chemicals that pose immediate or long-term health risks.

Further information

http://www.workcover.vic.gov.au

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19. Quality assurance

Definition
Quality assurance is the practice of establishing and implementing documented procedures that ensure food or product safety and quality.

Description
Quality assurance (QA) programs provide systems to demonstrate and help ensure production of commodities that are safe, of consistent quality and meet market requirements.

Each of the four main broadacre dryland agricultural industry sectors have established quality assurance programs. Recommended practice for the sheepmeat, beef and grains industries are systematic assessments of potential hazards to food safety and quality between paddock and plate. Critical points in the production chain are identified and processes to minimise hazards to safety or quality are documented. Compliance with procedures is subject to independent audit. A certification program has been developed to satisfy buyers that checks are in place.

Wool quality programs seek to ensure production systems meet pesticide residue benchmarks and that wool is not contaminated by foreign material (particularly those from shearing sheds) that would damage processing machines and cause dyeing difficulties.

Livestock industry programs are underpinned by the national animal identification system and vendor declarations so that the source and management of all livestock can be verified.

Implementing the practice
- Implement product quality assurance systems under the appropriate producer banner and where necessary seek accreditation or certification.
- Conduct regular audits and undertake appropriate corrective actions.

Benefits of implementation
Quality assurance systems:
- help ensure that products comply with market specifications;
- allow products to be sold into markets where safety and quality are valued;
- keep producers aware of market signals regarding product specifications and production systems;
- reduce the risk to farm workers and the environment of chemical contamination;
- reduce the impact of the introduction and spread of pests and diseases;
- protect the welfare of farm animals; and
- help ensure responsible environmental management.

Further information
http://www.dpi.qld.gov.au
http://www.mla.com.au
http://www.grdc.com.au
http://www.nswfarmers.org.au
http://www.austrmeat.com.au

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Quality assurance
Retention and management of native vegetation
Soil conservation
Tactical grazing
Tillage and stubble management
Waterway and floodplain management

Current Recommended Practice for Broadacre Dryland Agriculture
20. Retention and management of native vegetation

Definition

Retention and management of native vegetation is a practice to preserve, protect and maintain the integrity of ecological functions and biodiversity in retained native vegetation.

Description

This management practice addresses factors such as not clearing native vegetation, or limiting clearance to a level established by relevant legislation (or vegetation or environmental management strategies) and consistent with regional habitat needs and availability. This practice also includes approaches for restoration or enhancement of native vegetation.

Retention and management is concerned with the prevention of habitat modification (change in structure, composition or function of vegetation as a result of disturbance) and the improvement in environmental values of that habitat.

The practice includes fencing to manage stock access and encourage natural regeneration. Tactical grazing of native vegetation may sometimes be beneficial in managing fire hazard and weed populations. Maintaining different age classes of trees is also important, as is the retention of fallen and standing timber (dead trees) to preserve and provide habitat for wildlife.

Revegetation may be necessary in areas where the native vegetation is depleted or highly modified. This may be undertaken by planting tubestock or direct seeding. Local provenance seed, matching the ecological vegetation community, should be used for propagation wherever possible. Good site preparation (including soil disturbance and weed control) is essential for successful establishment.

Whole farm planning should identify locations of high value remnant vegetation and outline appropriate strategies for protection and maintenance as well as identifying areas to be restored and appropriately managed.

Retained native vegetation may be protected through nomination with voluntary conservation schemes, such as Land for Wildlife or by establishing a covenant on title.

Implementing the practice

* Consider native vegetation retention and rehabilitation in development of a whole farm plan, particularly the enhancement and connection of remnant patches to develop corridors and facilitate fauna movement.
* Monitor the condition and health of remnant native vegetation areas, including recruitment, weed populations and species composition.
* Apply appropriate cultural or biological controls for management of pest plants and animals.
* Work towards retaining 15 to 30 per cent of land under native tree cover.
* Maintain different age classes of trees and standing (dead) timber and re-establish ground and mid-storey vegetation composition and structure where necessary to preserve and provide habitat for wildlife.
* Fence remnants or revegetated areas to manage stock access.

Benefits of implementation

Retention and management of native vegetation:

* provides ecosystem goods and services (for example, pollination, biodiversity, water quality, soil health, nutrient cycling, habitat, carbon sink, seeds, honey, flowers, foliage, oils, genetic resources); 
* provides corridors to link fragmented vegetation remnants, provide habitat and wildlife corridors for animals; 
* maintains aesthetic, heritage, cultural and land values; 
* may improve productivity of the agricultural system due to predation of insect pests by insectivorous birds inhabiting native vegetation; 
* provides shelter for stock, crops and pastures; and 
* maintains or enhances biodiversity values.
Further information

Department of Natural Resources and Environment (undated) Native Pastures for Sustainable Agriculture, Victoria.


http://www.esa.gov.au
http://www.lwa.gov.au
http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
http://www.dipnr.nsw.gov.au
http://www.nrm.qld.gov.au
http://www.pir.sa.gov.au

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Retention and management of native vegetation

Soil conservation

Tactical grazing

Tillage and stubble management

Waterway and floodplain management
21. Soil conservation

Definition

Soil conservation is the practice of preventing physical and chemical degradation of soil, and the active rehabilitation or restoration of land degraded by salinisation, acidification, sodicity, erosion, waterlogging, non-wetting (hydrophobicity) and vegetation loss.

Description

Land degradation reduces productivity and is an important contributor to declining profit. Large areas of the Basin and some individual properties are affected by dryland salinity, soil erosion, vegetation loss and other forms of land degradation. Unless rehabilitated, it is likely that off-site impacts of degraded lands will continue (for example, sediment generation, salt export), as will the opportunity costs of lost production. Returning degraded land to production will help to redress this loss and provide other environmental benefits.

Establishment of salt-tolerant pasture or fodder species such as tall wheatgrass, Puccinellia, strawberry clover and saltbush is recommended in areas of saline groundwater discharge. Productive salt-tolerant pastures are used to replace unproductive volunteers, such as sea barley grass. If appropriately managed they can return unproductive land to productivity, maintain groundcover and reduce surface salt accumulation, wash-off and erosion. Where watertables remain shallow, salt is likely to continue to accumulate in the root zone of even salt-tolerant pastures. Engineering options, such as groundwater pumping and surface or sub-surface drainage, may also be used to lower watertables and help with reclamation of salt-affected land.

There are a variety of methods available for the reclamation of semi-arid rangelands that have been degraded by prolonged drought and overstocking. These methods may be based on mechanical soil disturbance (disc pitting and furrowing) to enable effective capture of run-off water, prescribed burning and active revegetation.

Steep hill country that is unsuited to agriculture is often recommended to be retired from production. It can be revegetated and managed to reduce the risk of further land degradation (from weeds, rabbits, erosion or salinity).

Contour banks may be used for erosion control in areas that are at risk because of soils, climate or topography. They are introduced to reduce the length of slope, slow overland flow and reduce sediment entrainment during rain. By reducing overland flow and sediment transport, they help to prevent gully and sheet erosion and reduce sediment deposition in streams and in lower slope positions.

Strip cropping is recommended for floodplain cropping areas in the northern regions of the Murray-Darling Basin. Strip cropping perpendicular to the direction of flood flows helps to spread water across the floodplain, reduce erosion and encourage water to infiltrate into soils for later use by crops.

Non-wetting sands are a major problem in agriculture in parts of the South Australian and Victorian mallee. Hydrophobicity results in poor and uneven penetration of water through the soil. This results in patchy crop or pasture growth and leaves some areas with little groundcover. Such areas are then vulnerable to wind erosion. The application of clay, organic matter or wetting agents increases water-holding capacity. Clay spreading can be expensive and is more commonly used in cropping areas. Benefits appear to be substantial and persist for many years. Cultivation practices, such as disc pitting, are more frequently used for pastures.

Conservation cropping practices reduce soil compaction and erosion and improve soil structure and biological health. See the sections on tillage and stubble management and integrated pest management.

Implementing the practice

* Monitor soil pH, nutrients and sodicity to guide lime, fertiliser and gypsum application.

Benefits of implementation

Soil conservation:

* increases carrying capacity of otherwise unproductive land;
* reduces overland flows, soil loss, sediment transport and loss of nutrients;
* improves water quality; utilisation of rainfall and flood flows, water infiltration and the water-holding capacity of soils;
* improves composition and biodiversity of degraded rangelands and pastures; and
* improves the farming family’s perception of their property.
Further information


http://www.dpi.vic.gov.au
http://www.dse.vic.gov.au
http://www.dipnr.nsw.gov.au
http://www.nrm.qld.gov.au
http://www.pir.sa.gov.au

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- Soil conservation
- Tactical grazing
- Tillage and stubble management
- Waterway and floodplain management

Agroforestry
Animal condition management
Breeding program
Business and financial planning
Chemical contamination avoidance
Commitment to family
Community and industry participation
Crop rotation
Effective management of labour and resources
Environmental monitoring and benchmarking
Identification and protective management of cultural heritage
Incorporation or retention of perennial species in pastures
Integrated pest management
Knowledge and skill development
Management according to land capability
Managing for weather and climate variation
Nutrient budgeting
Occupational health and safety plan
Quality assurance
Retention and management of native vegetation
22. Tactical Grazing

Definition

Tactical grazing is the practice of employing specific grazing regimes to meet the needs of pasture, soil and stock.

Description

Tactical grazing can include rotational and time control grazing, seasonal deferment or these strategies in combination with set stocking. Tactical grazing may be used in combination with fertiliser or herbicide application to manipulate pasture composition. It may also include set stocking at particular rates and for specific periods to achieve defined pasture composition or utilisation goals.

Rotational grazing either uses defined periods or defined feed and groundcover limits to govern grazing and spelling. Stock are normally rotated around a relatively small number of paddocks (three to five). Time control (or cell) grazing is a special case of rotational grazing, in which stock are rotated through a larger number of smaller paddocks, with grazing and spelling periods adjusted to match the time needed by the pasture to maintain good pasture quality. Seasonal deferment refers to situations where paddocks are not grazed in particular seasons to achieve certain goals. Objectives may include seed germination for native or introduced perennials, prevention of soil degradation by reducing animal traffic on wet sites, or maintaining groundcover on steep sites during periods of high erosion risk.

Feed budgeting incorporates decision rules in which the duration and intensity of grazing is based on green feed on offer (normally) and the lower limit of fodder availability to maintain groundcover. Stocking is generally set to achieve the lower limit in feed availability within a certain time period. It considers the specific grazing or spelling requirements of the pasture and seasonal variation in the demands of grazing stock.

Fodder conservation involves the temporary deferment of grazing. Feed is allowed to accumulate and then (generally) harvested in times when little fodder is available. The conserved feed may be provided to stock as hay or silage. Unharvested fodder in most pastures quickly declines in quality and may largely be wasted. Forage from shrubs in rangelands may be conserved as standing biomass, as it does not lose quality as rapidly as pasture-based forage.

Fodder conservation is less applicable in the northern Basin mixed farming zone as grain rather than fodder reserves is used to meet feed demands during periods of deficit. Fodder conservation, particularly hay cutting, may place considerable short-term stress on farming families and may conflict with social sustainability.

Opportunities to apply tactical grazing may be constrained in mixed farming situations by the paddock size requirements of the cropping phase. These constraints may be at least partly overcome by temporary (electric) fencing and aggregation of stock into relatively large mobs.

Timing of lambing and calving should match feed availability and market opportunities. Lambing and calving in late winter or early spring (in winter rainfall areas) allows the feed requirements to follow pasture production more closely than when young are born in autumn. Spring lambing and calving can only be sustained on perennial pastures. It reduces the need for supplementary feeding during winter and may allow paddocks to support higher stocking rates. Spring lambing may be recommended practice for wool growing on improved pastures but a mix of spring and autumn lambing and calving is required in beef and sheepmeat industries to maintain product availability.

Conservative stocking is an approach to the management of semi-arid rangeland that is particularly applicable to lands that are less responsive to rainfall. Reduced utilisation of available feed (given appropriate species composition – shrubs rather than annual grasses) allows a reserve to be maintained that may be used during prolonged dry periods. Conservative stocking generally produces greater profit through higher wool yields per sheep and higher profits per unit area. This trend does not hold when sheep numbers are already at the level where nutrition meets genetic potential or when kangaroo numbers are so high that they utilise reserved fodder.

In some areas, native fauna (especially kangaroos and wallabies), feral animals, stock and vertebrate pests add to total grazing pressure to the point where there is serious competition for feed with stock. This is most common in semi-arid rangelands, although it is increasingly reported in agricultural lands near conservation reserves and native forests. Management of fauna and pest animal populations may be required to prevent overgrazing and the threat this poses in relation to biodiversity (in rangelands and native grass pastures) and soil erosion.

Feed quality is a key determinant of methane emissions by stock, which in turn represents the major greenhouse gas output from established grazing enterprises. Grazing tactics (for example, rotational grazing) that maintain feed quality may help to reduce greenhouse gas emissions.
Implementing the practice

- Consider pasture, grazing and stock management practices in developing a farm business and marketing plan.
- Develop and implement a whole farm plan identifying paddocks, laneways and crop or stock access areas.
- Monitor feed availability, quality, composition and groundcover levels.
- Budget feed, based on stock requirements, groundcover targets and pasture growth expectations.
- Develop and apply grazing tactics that meet the needs of pastures, stock and soil in various areas of the property. This generally involves some form of rotation or time-controlled grazing.

Benefits of implementation

Tactical grazing:

- improves persistence and density of perennials in mixed pastures;
- allows accumulation of leaf and encourages optimum growth and water use;
- increases pasture utilisation and carrying capacity;
- improves pasture composition and helps maintain groundcover;
- reduces the need for herbicides to maintain desirable composition;
- reduces surface run-off and erosion;
- may help to manage damage caused by animal traffic when susceptible soils are wet;
- reduces the spread of worms and diseases;
- provides for supplementary feeding at times of low pasture production;
- improves the resilience of the production system;
- improves wool production and financial returns; and
- reduces greenhouse gas emissions.

Further information

Ransom, K. *Dryland Lucerne Grazing Systems*. Research Report Series No. 136, Department of Food and Agriculture, Bendigo.


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23. Tillage and stubble management

Definition

Tillage and stubble management comprise practices that minimise the impacts of vehicle traffic and cultivation on soil structure and biological health through avoiding or minimising tillage and retaining crop residues.

Description

Conservation cropping comprises a number of individual practices undertaken together. It commonly involves stubble retention, zero or minimum tillage, integrated pest management, crop rotations and whole farm planning. It may include controlled traffic cultivation (where the tractor follows exactly the same path for planting, cultivation, if any, and spraying over a number of years) and precision farming in large-scale enterprises.

Reduced cultivation methods such as direct drilling, minimum tillage and zero tillage were developed to reduce the impacts of vehicle traffic and cultivation on soil structure and general soil health. They help to maintain or improve soil organic matter content, improve water and air infiltration, soil structure and biological health and reduce the compactive effects of cultivation and vehicular traffic. Improved water storage and crop yields can also be achieved. Tractor and implement operating times are reduced, although this may increase herbicide usage and resistance. Reduction in cultivation effort reduces labour demand at around sowing time, energy usage and (variable) input costs.

Stubble retention or mulching is practised to maintain groundcover, reduce soil erosion and increase soil organic matter input. This, in turn, encourages root development, improved water infiltration, reduced soil aggregate breakdown and may lead to reduced run-off and greater water use. Strip cropping is practised in northern Basin floodplain cropping areas to provide protection from erosion and to maximise the spread and utilisation of floodwaters.

Crop rotation planning should consider the retention of stubble. Crops such barley and wheat provide effective stubble cover and should be included in rotations with low stubble crops (for example, lupins, chickpeas, cotton). Stubble retention reduces greenhouse gas emissions from cropping land and may help to create a carbon sink.

Implementing the practice

* Identify different land classes and manage according to capability.
* Retain and manage stubbles to improve water infiltration and soil health and reduce soil erosion risk.
* Implement strip cropping layouts in northern Basin floodplain landscapes.
* Manage crop rotations to maintain groundcover and soil organic matter.
* Minimise traffic and cultivation during crop establishment.
* Develop and implement whole farm planning to identify traffic corridors (if a controlled traffic system is to be used), to reduce ad hoc vehicle traffic across paddocks and prevent widespread soil compaction.

Benefits of implementation

Tillage and stubble management:
* reduces soil erosion and compaction and improves soil organic matter content, soil structure and soil biological health;
* improves water infiltration and reduces surface run-off;
* improves water storage and rainfall usage efficiency;
* reduces cultivation effort and the costs of machinery and other inputs;
* encourages growers to operate production systems within land capability constraints;
* improves yields and net returns from crops; and
* reduces greenhouse gas emissions.
Further information


http://www.grdc.com.au
http://www.nrm.qld.gov.au
http://www.agric.nsw.gov.au

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Integration or retention of perennial species in pastures
24. Waterway and floodplain management

Definition
Waterway and floodplain management is the practice of providing protection for waterways and floodplains and maintaining their natural function without further degradation.

Description
Riparian land is any land which adjoins or directly influences a body of water, including the land immediately alongside streams, gullies and swales which sometimes runs with surface water. It also includes land surrounding lakes and wetlands and floodplain areas which interacts with rivers during times of flood. Depending on the nature of the landscape and the adjacent land use, the width of the riparian land that requires special management will range from a very narrow strip through to a wide, densely vegetated corridor. Riparian areas are often highly productive, which makes them vulnerable to overuse.

Direct watering of stock from streams is frequently associated with bank degradation and poor water quality. The provision of off-stream reticulated water should eliminate the need for uncontrolled stock access to riparian zones and, if accompanied by fencing, will reduce the damage this can cause.

Strips of perennial pasture grasses along streams may filter sediment from overland flow and so reduce nutrient transport to streams. Use of perennials in upland areas increases surface roughness and may help to reduce run-off and the risk of flooding and flood-induced groundwater recharge in low lying areas.

In floodplain areas, maintenance of a short and dense cover of perennial grass may help to spread flood flows and reduce erosion during floods. In southern Basin areas, perennials in floodplains may help to reduce flood-related recharge (although potentially invasive species whose seed can be distributed by water should not be used). Strip cropping is recommended in floodplain cropping areas in the north of the Murray-Darling Basin to divert or spread flood flows, reduce erosion and make productive use of rainfall. Farm infrastructure, including fences, roads and tracks should be located carefully (if they are necessary) to prevent creating barriers to flow in such areas.

Tactical grazing may be required to manage groundcover and weeds in riparian and floodplain areas.

Snags and other large wood in streams should generally be retained to provide habitat and food for aquatic ecosystems and create irregular and more natural stream channels.

Woody weeds along streams (for example, willows, blackberries) should be removed and replaced with native species (from local provenance seed) according to the ecological vegetation class.

Implementing the practice

* Develop a whole farm plan identifying waterway and floodplain areas and manage them according to land capability, recognising differences in pasture, soil type, water balance and waterlogging. Protect waterways from nutrient, sediments, pest plants and animals, and chemical contamination.

* Manage and (as necessary) rehabilitate riparian vegetation. Link riparian corridors.

* Construct off-stream watering or develop hardened stream access points for watering of stock.

Benefits of implementation

Waterway and floodplain management:

* decreases erosion of topsoil and stream banks and beds;
* improves water quality through reduced sediment delivery and fouling by stock;
* maintains healthy riparian ecosystems;
* reduces migration of river channels and associated infrastructure damage;
* decreases insect pests due to predation by insectivorous birds and insect parasites that find habitat in protected riparian vegetation;
* decreases algal growth – riparian vegetation helps control the light and temperature levels which help prevent the growth of nuisance plants and algae;
* increases capital value of property;
* provides shade and shelter for stock; and
* allows deep-rooted vegetation, in some circumstances, to lower riparian watertables, reducing the flow of salt and nutrients into streams from groundwater;
Current Recommended Practice for Broadacre Dryland Agriculture

- helps maintain a suitable habitat for aquatic animals, including insects, fish and crustaceans; and
- provides recreational resources that produce income for landholders and regional communities.

Further information


http://www.lwa.gov.au

Links to sustainability goals

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Agroforestry

Animal condition management

Breeding program

Business and financial planning

Chemical contamination avoidance

Commitment to family

Community and industry participation

Crop rotation

Effective management of labour and resources

Environmental monitoring and benchmarking

Identification and protective management of cultural heritage

Incorporation or retention of perennial species in pastures

Integrated pest management

Knowledge and skill development

Management according to land capability

Managing for weather and climate variation

Nutrient budgeting

Occupational health and safety plan

Quality assurance

Retention and management of native vegetation

Soil conservation

Tactical grazing

Tillage and stubble management

Waterway and floodplain management
Sources used in the preparation of current recommended practice documentation

Personal consultation

The following were personally consulted during the process of preparing this document. Affiliation is that applying at the time of the consultation.

* Angela Avery – Landmark Team 3a Leader, Agriculture Victoria, Department of Natural Resources and Environment
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* Bill Davies – Program Manager, Land Management, Sustainable Resources, Primary Industries and Resources South Australia
* Denys Garden – Research Scientist, NSW Agriculture.
* Andy Hermiston – Wool Producer, Landmark Steering Committee
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* Bill Johnston – Research Scientist, Department of Land and Water Conservation, NSW
* Sarah Lewis – Policy Development Officer, South Australian Farmers’ Federation
* Megan Leyson – Research Officer, Grains Council of Australia
* Kate Lockhart – Executive Officer, Land Management Committee, Victorian Farmers’ Federation
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* Doug Reuter – Principal Scientist, CSIRO Land and Water, Adelaide.
* Hamish Cresswell – Principal Scientist, CSIRO Land and Water, Adelaide.
* Professor David Coventry – Department of Agronomy and Farming Systems, University of Adelaide
* Dr Reg French
* David Heinjus – Rural Directions Pty Ltd
* Dr Peter Wylie – Horizon Rural Management Pty Ltd

Publications

Tillage and stubble management

Effective management of labour

Business and financial planning

Animal condition management

Retention and management of perennial species in pastures

Incorporation or retention of perennial species in pastures

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Waterway and floodplain management


Department of Agriculture. Lucerne for Profit, Bendigo.


Department of Natural Resources and Environment (undated) Native Pastures for Sustainable Agriculture. Victoria.

Department of Natural Resources and Environment (undated) Safe, Quality Food from Environmentally Responsible Agriculture. Victoria.


NSW Agriculture (undated) Conserving our Farming History: CB Alexander Agricultural College, Tocal.


Sinclair Knight Merz (1999) Assessment of Vegetation Options for Dryland Salinity Management, Broken and North Goulburn Plains Salinity Study, Department of Natural Resources and Environment.


Virtual Consulting Group (1990) Farm Forestry Feasibility Study for North-Central and Wimmera Catchment Authority Areas and Buloke Shire. Department of Natural Resources and Environment, Bendigo.


Websites:

http://www.rirdc.gov.au
http://www.brs.gov.au
http://www.nff.org.au
http://www.agric.wa.gov.au
http://www.csiro.au/faculty/sciagr/
http://www.farmwide.com.au
http://www.dpi.qld.gov.au
http://www.wool.com.au
http://www.abc.net.au/landline
http://www.csiro.au
http://www.lwa.gov.au
http://www.amlc.com.au
http://www.affa.gov.au
http://www.ea.gov.au
http://www.workcover.vic.gov.au
http://www.crc.org.au
Integrated catchment management in the Murray-Darling Basin

A process through which people can develop a vision, agree on shared values and behaviours, make informed decisions and act together to manage the natural resources of their catchment: their decisions on the use of land, water and other environmental resources are made by considering the effect of that use on all those resources and on all people within the catchment.

Our values
We agree to work together, and ensure that our behaviour reflects the following values.

Courage
- We will take a visionary approach, provide leadership and be prepared to make difficult decisions.

Inclusiveness
- We will build relationships based on trust and sharing, considering the needs of future generations, and working together in a true partnership.
- We will engage all partners, including Indigenous communities, and ensure that partners have the capacity to be fully engaged.

Commitment
- We will act with passion and decisiveness, taking the long-term view and aiming for stability in decision-making.
- We will take a Basin perspective and a non-partisan approach to Basin management.

Respect and honesty
- We will respect different views, respect each other and acknowledge the reality of each other's situation.
- We will act with integrity, openness and honesty, be fair and credible and share knowledge and information.
- We will use resources equitably and respect the environment.

Flexibility
- We will accept reform where it is needed, be willing to change, and continuously improve our actions through a learning approach.

Practicability
- We will choose practicable, long-term outcomes and select viable solutions to achieve these outcomes.

Mutual obligation
- We will share responsibility and accountability, and act responsibly, with fairness and justice.
- We will support each other through the necessary change.

Our principles
We agree, in a spirit of partnership, to use the following principles to guide our actions.

Integration
- We will manage catchments holistically; that is, decisions on the use of land, water and other environmental resources are made by considering the effect of that use on all those resources and on all people within the catchment.

Accountability
- We will assign responsibilities and accountabilities.
- We will manage resources wisely, being accountable and reporting to our partners.

Transparency
- We will clarify the outcomes sought.
- We will be open about how to achieve outcomes and what is expected from each partner.

Effectiveness
- We will act to achieve agreed outcomes.
- We will learn from our successes and failures and continuously improve our actions.

Efficiency
- We will maximise the benefits and minimise the cost of actions.

Full accounting
- We will take account of the full range of costs and benefits, including economic, environmental, social and off-site costs and benefits.

Informed decision-making
- We will make decisions at the most appropriate scale.
- We will make decisions on the best available information, and continuously improve knowledge.
- We will support the involvement of Indigenous people in decision-making, understanding the value of this involvement and respecting the living knowledge of Indigenous people.

Learning approach
- We will learn from our failures and successes.
- We will learn from each other.
Current recommended practice
A DIRECTORY FOR BROADACRE DRYLAND AGRICULTURE

Craig Clifton, Camille McGregor, Roger Standen & Simon Fritsch