Establishment of Environmental Management Systems for the Olive Industry

by Nelson Quinn

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Foreword

The Australian olive industry continues to grow and to promote efficiency, quality and excellence in all industry operations from plant nursery to consumer.

The industry at every level is dependent on olive growing, which in turn is dependent on natural systems and the environment. All aspects of the industry have environmental impacts.

The industry’s voluntary Code of Practice supporting authenticity and quality in the industry acknowledges that good environmental management is an important element of quality and of public confidence.

This report builds on past research work and practical experience across many industries and in many countries.

The project relied on substantial voluntary industry activity with a financial contribution from RIRDC Core Funds, which are provided by the Australian Government.

This report is an addition to RIRDC’s diverse range of over 2000 research publications and it forms part of our Olives R&D program, which aims to:

- provide information which establishes the benefits of Australian olive products
- maintain the current high quality product while improving productivity, profitability and environmental management through all stages of the supply chain
- develop strategies for existing and new olive producers to reduce the effects of climate change and variability
- build an educated, collaborative, innovative and skilled industry workforce and a cost effective, well-funded RD&E program.

Most of our publications are available for viewing, downloading or purchasing online at www.rirdc.gov.au. Purchases can also be made by phoning 1300 654 313.

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Nelson Quinn is an olive grower and a shareholder in an olive processing plant; he has been a shareholder and director in another processing and olive oil marketing company. He has been an active member of olive industry associations for many years, and of the landcare movement. As a result of these activities and many years’ experience in environmental policy and management, he became involved in the development and operation of the Australian Land Management Certification System. He is a director of the not-for-profit managing organisation, Australian Landcare Management System Ltd.

Acknowledgments

This report builds on a very large body of research work in Australia and overseas on the major environmental issues of the day that might affect the olive industry, and on the policy and market place responses to those issues. There have been discussions with many people in the industry and elsewhere. A special debt is owed to the global change research community whose work over the last five years provides a solid foundation for dealing with industry-environment relationships, to the many people who have trialled and reported on different approaches to quality and environment management, and to RIRDC for initiating and publishing several reports in recent times on topics central to the subject matter of this report.

Abbreviations

ALMCS  Australian Land Management Certification System
ALMS  Australian Landcare Management System
EMS  Environmental Management System
EPR  Extended Producer Responsibility
GRI  Global Reporting Initiative
HACCP  Hazard Analysis Critical Control Point
ICC  International Chamber of Commerce
RIRDC  Rural Industries Research and Development Corporation
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Executive Summary

What the report is about

This report analyses the relationship between the olive industry and the environment and natural systems, and develops proposals for improving environmental management throughout the industry in the interests of quality products, production efficiency and public reputation.

The olive industry from plant nursery through olive production, processing, food and cosmetic manufacturing, to sales and consumption, with associated transport and storage, involves considerable interaction with the environment. Along with other agricultural industries, olive growing is dependent on the environment, and all other parts of the industry are dependent on successful olive growing.

Who is the report targeted at?

The environmental management system and charter described in this report underpins the Australian Olive Association’s Code of Practice.

The report can be used by individual enterprises, suppliers and contractors to the industry, olive industry associations from regional to national level, governments and others who interact with the industry, and research organisations.

Where are the relevant industries located in Australia?

The olive industry in Australia involves plant nurseries, olive groves, processing for oil and table olives, manufacturing of food products and cosmetics, and wholesale and retail sales. There are many supporting industries, such as plant nursery suppliers, rural suppliers and contractors, transport, refrigeration and storage suppliers, specialised machinery suppliers and marketers.

There are seven million or more olive trees planted in Australia. They are located in all states and the Australian Capital Territory, and in the majority of Australia’s agro-ecological zones, with most in the temperate areas. There are small to large processing plants in all the olive growing areas.

The size of both groves and processing plants ranges from very small to very large.

The majority of the olive trees now in production have been planted over the last fifteen years or so, many now reaching maturity. Production of olives, and hence olive oil, table olives and other products, is now increasing rapidly. About 40 per cent of the olive oil produced in Australia is exported, with the rest sold in Australia under many brands, from small, local boutique brands to national supermarket brands.

The industry therefore has extensive and potentially far-reaching environmental impacts from nursery to consumer. It is also dependent on the environment and natural systems. Its viability, year-to-year profitability, long-term sustainability and public image depend on the industry’s interaction with natural systems.
Background

The Australian Olive Association has accepted the need for environmental management systems in the industry. The industry’s voluntary Code of Practice supporting quality products now requires the use of environmental management systems based on continuous improvement principles with attention to biodiversity. Commitment to good environmental management is increasingly common in the business world, often manifested by environmental charters, specific environmental programs, environment reporting and environmental standards for suppliers and contractors. It is often stated that consumers increasingly have regard to environmental factors when making choices in the marketplace.

The industry’s voluntary Code of Practice requires the use of environmental management systems based on continuous improvement principles

Aims/objectives

The aim of the research has been to simplify and accelerate the take up of sustainable environmental practices in the olive industry, and to provide a sound basis for olive industry inputs into more generic environmental management system developments.

Methods used

The report is based on literature searches, discussions with olive industry members and outside experts, direct olive growing, processing and marketing experience, and other personal knowledge gained from twenty-five years’ experience in environmental policy and program development and implementation in Australia and overseas. The report is also based on personal participation in various directly relevant conferences and events, such as Fenner Conferences, Environmental Management Systems Association and Australian Landcare Management System Ltd activities, commonwealth and state government conferences on environment management systems, and conferences and workshops concerning Codex Alimentarius, greenhouse/global warming, and landcare. The report takes into account outcomes from olive industry and Horticulture Australia Ltd events, and quality management events. The report is also grounded in substantial personal involvement in major industry developments that provide the framework for quick and effective implementation of environmental management systems (and other things) in the industry, in particular, achieving a national, unified industry structure, a Code of Practice for product quality and authenticity and an Industry Biosecurity Plan.

Results/key findings

The need for action on improving environmental management flows from obligations under the industry’s voluntary Code of Practice, legal obligations and regulatory systems, market requirements, community expectations, cost pressures and biosecurity concerns.

Effective action should cover day-to-day management such as pest control and waste management as well as the major issues such as climate change. The industry has to accommodate them all.

Systems used in the industry also need to accommodate great differences across the industry in respect of scale, skills and knowledge, location, type of business and access to resources.

There are relatively unknowable risks from factors such as climate change and natural climate variability and their interaction with

Systems used need to accommodate great differences across the industry of scale, skills and knowledge, location, type of business and access to resources.
local and international economic and social drivers. Therefore systems need to be flexible, capable of being customised to suit individual circumstances and capable of reducing vulnerability to change, providing competitive advantage and should not just be reactive. These points reinforce the need for a strong research and development program for achieving and maintaining quality and achieving production efficiency over the long-term, using the environment as its cornerstone. Achieving this essential element of successful industry development is hampered by the absence of a compulsory research and development levy as is available for many other agricultural industries, including competitors of the olive industry.

There is a very great amount of information available to assist people in the industry. This amounts, however, to an indigestible information overload. Extension services tailored to the whole range of circumstances in the industry need to be available to overcome this problem.

There are many approaches available for increasing the quality of environmental management. The approach recommended is based on international standards, is proven operationally, comes with support, is linked to regional systems, supports attention to biodiversity, and can be applied easily to all land uses and enterprises.

Although the concept of an environmental management system is well known and accepted, the take up is low. Whatever approach is adopted needs to be supported by an implementation program that overcomes inhibitions to take up.

The industry as a whole can adopt a progressive environmental charter, as many other organisations have done, to contribute to its public image and provide a foundation for action by individual enterprises.

As the environmental impacts of the different elements of the industry are well known in general terms, individual enterprises can act now using the action guides, risk assessment advice and list of generally common issues in the report.

There is a core set of information that any enterprise can start with. This obviates the need for all to start afresh with the very large amount of currently available material. This core information extends beyond olive growing, recognising that many olive growers are also responsible for other land uses.

**Implications for relevant stakeholders**

The industry as a whole will benefit from implementing good, internationally acceptable environmental management systems as a contribution to a continuing favourable public image. Particularly if environmental issues become the cornerstone of industry research and development, the industry’s vulnerability to unpredictable events – as might arise from climate change and input price shocks – can be significantly reduced.

Individual enterprises will benefit from simpler compliance with industry Code of Practice, legal and regulatory compliance and reduced costs. They will have a better platform for marketing, continuing access to markets and for generating a good public image among their neighbours and in the marketplace.

Communities in which the industry operates will benefit from an industry that is viable for the long term, that is reducing its impact on the environment, and that contributes to other local industries such as tourism as well as supporting other local businesses. Consumers benefit from continuing access to quality products.
Policy makers, program managers and regulators at all levels of government can have greater confidence in the industry’s capacity for compliance and, on a more positive note, the industry and the people in it can contribute to policy and program development and effortlessly fit in with policies and programs.

Many researchers, educators and trainers will benefit from the action proposed in the report. This action will generate continuing demand and support for research on every aspect of the industry, on general global change issues and on the contribution of the industry to issues of public good. There will be continuing demand for education and training services.

**Recommendations**

The recommendations are aimed at the industry as a whole, for example, through action by the Australian Olive Association, at individual enterprises, and at industry supporters, including those in the research world.

There are recommendations aimed at achieving successful integration of environmental considerations into every aspect of the olive industry, and at providing a basis for evaluation of progress. The report includes further detailed recommendations for a progressive industry policy, to assist the industry to adopt good environmental management, for national action to support growers and processors in their environmental management endeavours, for essential research and development, and for ensuring continuing industry commitment and action.

Adoption of the recommendations will contribute substantially to success factors for new rural industries identified in recent RIRDC research.
1. The big picture

The olive industry, from nurseries to olive groves to processors and traders and retailers, can prosper only from successful olive growing, which is dependent on natural systems. The economic and social impacts of the olive industry are extensive, as more and more suppliers of goods and services and rural communities benefit from it.

The industry has emphasised quality and value for customers in Australia and overseas where Australian products are sold. In other industries, environmental factors (and other social responsibility issues) are being included in quality definitions and in promotion to consumers and governments and other private decision-makers. This environment–quality relationship is a natural fit for primary-industry based products like olives, as a failure to manage environmental issues effectively will inevitably lead to the demise of the industry because of declining terms of trade, public opprobrium and restrictive regulation. Those who deal best with these issues will have the best prospects for long-term success.

The many pressures on the industry include increasing costs of production, the impact of environmental factors such as droughts, pests and diseases, and wider, longer-term global changes, and competition, from overseas for olive products, and from everywhere for the consumer spend on fine foods generally.

The industry has to act in concert with others in the supply chain, many of whom now embrace advanced local and international sustainability and environmental goals and systems.

Immediate and further afield neighbours are always interested in the impact and appearance of agricultural enterprises and food manufacturing businesses. Unless the industry is popular locally and with other industries and government decision-makers, it will suffer distractions, reverses and loss of reputation and it will attract detailed regulation and surveillance.

The wider public includes current customers and potential new customers, whose loyalty and interest will be influenced by the industry’s image and reputation. Some in the wider public here and overseas will scrutinise the industry, as they do industry generally, from social responsibility perspectives, which now clearly include the environment.

The industry benefits from a positive relationship with governments at all levels. Confidence among government interests about the quality of the industry’s environmental efforts will help maintain these good relationships.

It is therefore to the industry’s advantage to maintain and demonstrate good and ever-improving environmental management to increase its resilience and adaptability in the face of cost pressures and external environmental factors, reinforce its quality image, keep up with others in the supply chain, continue to impress its customers and the general public, and maintain its good relationships with government agencies.

As elaborated in this report, these interests of the industry will be best served by adopting progressive goals and systems for management based on fitting in with natural systems and working towards nature-inspired processes so that everything the industry generates or uses ends up as something else of value – rather than as waste.

The environmental issues caused by, and affecting, the industry are not hard to identify, even if they vary in character and significance from place to place and time to time. There is now a vast amount of information available about environmental issues and how to deal with them. The proposals in this report are aimed at making this mass of information accessible and useful for those in the industry, at building systems that will persist and improve, and at encouraging maximum, willing and productive participation by all in the industry.
In the past, success in human activities generally has come from being better than others in a ‘business as usual’ way. One of the most important lessons from the global changes now well underway is that the past is no longer a reliable guide to the future. The changes affecting all industries are non-linear and the outcomes unpredictable.

As RIRDC points out, Australia’s producers are faced with a dynamic, uncertain environment where issues emerge and change quickly, and climate change and the policy responses to deal with it that may present challenges to productivity growth and prosperity in the sector (RIRDC 2010).

There will continue to be inhibition and hesitancy about developing and pursuing new approaches in the community generally. The long-term winners will be those who most quickly and effectively overcome these traditional psychological barriers. The December 2009 Sensis Business Index report on Small and Medium Enterprises indicates that only 41 per cent of these (most olive industry businesses are in this group) have made changes to their business to respond to environment concerns (Sensis 2009). It has been pointed out that this ‘follower’ approach can disadvantage businesses: It’s very rare that the followers grab the opportunity and capture the opportunity the same way as the leaders and innovators do.¹ Consistent with this, a European study suggests that ... there is much to gain for front-running producers and retailers in adapting to new challenges such as climate change in dealing with marketing and communication (Retail Forum for Sustainability 2010). The lack of action by the majority provides an opportunity to meet and exceed community expectations and increase profitability through progressive action. One observed barrier to action on these issues in Australia has been the absence of vertical integration in many industries.² The olive industry with substantial vertical integration and a unified, strong industry association therefore has an inbuilt advantage.

Everyone in the industry is an environmental manager. And, becoming better environmental managers will have many advantages. Taking the positive steps proposed in this report will allow the industry to gain these advantages and to anticipate and deal quickly and effectively with new developments rather than just react after changes. For long-term success, the industry will need to be active, alert and adaptive, rather than tied to history and to passive reaction to the changing world in which it operates. It will need to embrace systems that accommodate uncertainty and change while retaining a focus on the straightforward goals of quality, efficiency and reputation.

On the other hand, doing nothing is not a viable option, as the circumstances in which the industry operates continue to change. Growers, processors and marketers are already using energy, water and fertilisers and facing increasing cost and marketing pressures.

With the knowledge we have now, the outlook for positive long-term results through structured actions is greater than ever before.

² Comment by S Heilbron, Executive Officer, SAI Platform Australia, at NRM Corporate Engagement – What’s Working Forum, Canberra, 9 June 2010
2. The background

2.1 Setting the stage

The conclusions in a 2004 RIRDC report on environmental management in the Australian olive industry (Quinn 2004) were endorsed at the Australian Olive Association’s national conference held in Perth in September of that year. RIRDC then agreed to support further work on implementing environmental practices and systems in the industry.

The 2004 report’s conclusions included the value of the use of environmental management systems in the industry, strategies to reduce environmental impacts, the potential from joining various government programs, suggestions for research and development and an outline of training needs.

The environment is more prominent in the public mind than ever because of the continuing drought in many parts of Australia, other extreme weather events, and because of global warming and other global change issues. The public feels the effects of fluctuating supplies and prices for food. Olive growers are reminded that their industry is dependent on climate and environment. The industry is basically restricted to temperate areas even with technological assistance such as irrigation or frost mitigation.

The rest of the olive industry supply chain does not, of course, exist without successful olive growing, so every actor in it, from contractors and rural service providers to retailers, benefits from successful high quality olive growing and processing.

All in the industry are environmental managers. Many other industries already have environmental policies and systems. In the olive industry case, good environmental management has already been incorporated in the concept of quality through its inclusion in the voluntary Code of Practice. This code supports quality and authenticity in the industry to generate confidence in consumers.

The industry concept of quality embraces the products and the industry as a whole. As well as providing quality products, the industry needs to be seen as a ‘good neighbour’ wherever it operates. The industry will benefit from respecting the environment while achieving financial viability and contributing to regional and national social and cultural wellbeing.

A positive, environmentally sensitive approach will put the Australian olive industry at the forefront of current developments. One of the committees of the International Standards Organisation, with Australian representation, has prepared a draft document – Guidance on Social Responsibility – that includes the environment as a core social responsibility (ISO 2008). It would be naïve to assume that the development process will not influence community expectations, even if it does not lead to a certifiable management standard. For instance, Walmart, the world’s biggest retailer, is developing strong environmental tests for its suppliers to meet (see elaboration in Chapter 5, Section 5.1).

The industry’s voluntary Code of Practice applies at the moment only to producers and traders of extra virgin olive oil. It is being extended to table olives. The code will, however, affect the operations of olive fruit suppliers, rural services providers and contractors to the industry.

Some members of the code, for example, major grocery wholesalers and retailers, will no doubt expect their suppliers to do no less than they do in environmental management. Several olive interests are already members of the Sustainable Agriculture Initiative or SAI Platform, an international organisation supporting sustainable agriculture. It supports action on a large range of environmental issues from the perspective of how to optimise the use of natural resources and minimise inputs, while at the same time protecting and improving the natural environment. Some are also members of the United Nations Global Compact (UN Global Compact Office 2011), which was launched in 2000 and requires its members to align their operations and strategies with ten universally accepted social responsibility principles relating to human rights, labour and anti-corruption, and also including three relating to the environment. Members are asked to:
support a precautionary approach to environmental challenges
- undertake initiatives to promote greater environmental responsibility
- encourage the development and diffusion of environmentally friendly technologies.

The Australian Network of the Global Compact was launched in May 2009.

There are now reports and other research clarifying various issues that were under notice in 2004 (see Appendix 1), some only becoming available in 2009 and 2010. These have settled some issues about management systems, provided better support systems, contributed to the adaptation necessary to deal with the global changes that have been occurring for at least two hundred years and provided useful comparative material from Europe.

The olive growing industry, and hence the whole olive industry, is dependent on natural systems and forces, currently subject to continuing global changes affecting Australia as well as the rest of the world. An effective environmental approach must comprehend this critical background issue. Major international reviews of the current state of knowledge are referred to in Chapter 4 and in Appendices 2 and 3.

The major pillars for success and longevity for the olive industry are high quality and productivity. Effective environmental action throughout the industry is critical. Good environmental management is a component of quality, a concept embracing clean, green products as well as a good public image, a link well illustrated by the increasing emphasis given to environmental issues in quality assurance circles, for example, at the TQA Australia conference in November 2009. Public image includes being a ‘good neighbour’ in regions where olive growing and processing occurs. Good environmental management reduces costs, optimises use of natural systems and, in many situations, should increase productivity.

The industry has made a strong start by including the following as an obligation of signatories to its voluntary Code of Practice (AOA 2009):

1. ensure compliance with all laws and regulatory requirements affecting or relating to environmental outcomes that are relevant to the production of products for which the Code of Practice has quality and related requirements

2. demonstrate a commitment to implement and maintain an environmental management system based on continuous improvement principles within two years of becoming a signatory, and

3. include conscious attention to biodiversity issues in that system.

In October 2009, an industry biosecurity plan was released for the olive industry (Plant Health Australia 2009). The plan was prepared collaboratively by Plant Health Australia, industry representatives, and government officials. It deals with plant health risks, thereby contributing to environmental management in the industry.

All of these factors – heightened awareness of environmental issues and the industry’s dependence on them, the Code of Practice, important research and other reports over the last few years, and clearer understanding of the significance of environmental management for the long-term success of the industry – mean that the outlook for positive and effective action in the industry is greater than ever before. On the other hand, doing nothing is not a realistic approach, because of increasing cost and marketing pressures and the dependence of the industry on the environment.

This report includes information on the environmental impacts of the industry, a brief description of the natural systems on which it depends, and proposals for successful implementation of environmental management systems and supporting arrangements.

4
To summarise:

- the whole industry, from nursery to retailer, is dependent on successful olive growing
- all in the industry are environmental managers
- olive growing is dependent on the environment and its natural systems
- the industry has accepted that its quality framework requires good environmental practices
- there is an opportunity to gain competitive advantage through meeting and exceeding community expectations
- the outlook for positive and effective action is greater than ever before, and
- doing nothing is not a realistic approach.
3. The industry’s environmental impacts

3.1 The impacts

There is a need to identify all the process steps from land management to consumer waste management so that all environmental impact points of the industry are known. Doing this has benefits going beyond environmental management, as it is also useful for enterprise planning and management, assessing cost structures and in applying HACCP principles – the first two, important for profit, and the third, necessary for food law compliance and industry Code of Practice participation.

Table 1 summarises the impacts the olive industry has on the environment. The nature and extent of these will vary from place to place and depend in part on particular practices adopted by different enterprises. Only mechanical processing for oil production is included. Refining oil raises more environmental issues, but presently this occurs only occasionally in Australia, and as part of the refined oil, rather than olive, industry.

Table 1: Olive production – environmental impacts

<table>
<thead>
<tr>
<th>Activity</th>
<th>Inputs and issues</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site selection and preparation</td>
<td>topography, location in respect of streams and native vegetation, mechanical site preparation, soil additives, irrigation, herbicides, land clearing, energy</td>
<td>changes to local ecology, hydrology, biodiversity and soil characteristics, atmospheric changes</td>
</tr>
<tr>
<td>Grove or nursery establishment</td>
<td>mechanical equipment and activities, energy</td>
<td>as above</td>
</tr>
<tr>
<td>Grove or nursery management</td>
<td>irrigation, soil management, weed control, ‘olives as weeds’, inter-row management, herbicides, fertilisers, livestock, pruning, energy</td>
<td>as above</td>
</tr>
<tr>
<td>Crop management</td>
<td>mechanical equipment and activities, fertilisers, herbicides, other chemicals, weather and pest protection, ‘olives as weeds’, energy</td>
<td>as above</td>
</tr>
<tr>
<td>Harvesting and crop transport</td>
<td>mechanical equipment and activities, containers, cleaning, ‘olives as weeds’, energy</td>
<td>as above</td>
</tr>
<tr>
<td>Processing</td>
<td>mechanical equipment and activities, chemical use, buildings, water use, cleaning, waste, internal climate control, containers, energy</td>
<td>lower order changes to local ecology, hydrology, biodiversity, atmospheric changes; potential for pollution of land and water</td>
</tr>
<tr>
<td>Storage, transport and sales</td>
<td>mechanical equipment and activities, buildings, cleaning, waste, internal climate control, containers, energy</td>
<td>as above, subject to high variability of impacts</td>
</tr>
<tr>
<td>Consumption</td>
<td>domestic transport and storage, waste, energy</td>
<td>as above</td>
</tr>
</tbody>
</table>
Another way of looking at these issues is in Table 2, based around environmental issues rather than industry practices. These can also be sub-divided or elaborated, but, however set out, it is obvious that many industry activities involve intervention in natural cycles and systems, and so the industry has a significant impact on the environment.

Table 2: Environmental issues and the olive industry

<table>
<thead>
<tr>
<th>Issue</th>
<th>Olive production</th>
<th>Processing</th>
<th>Sales and distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity</td>
<td>site selection, site preparation, hydrology changes, irrigation, chemical use, energy, weed management, ‘olives as weeds’</td>
<td>hydrology changes, water use, chemical use, waste, site management, energy</td>
<td>water use, waste packaging, energy</td>
</tr>
<tr>
<td>Land and soil condition</td>
<td>site selection, site preparation, hydrology changes, irrigation, chemical use, weed management, machinery use, inter-row management</td>
<td>water use, chemicals, waste</td>
<td>waste</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>site preparation, hydrology changes, chemical use, inter-row management, energy</td>
<td>water use, chemicals, waste, energy</td>
<td>water use, chemicals, packaging, transport, waste, energy</td>
</tr>
</tbody>
</table>

There is further elaboration of environmental issues related to horticulture in Guidelines for Environmental Assurance in Australian Horticulture issued in 2006 by Horticulture Australia Ltd (Lovell 2006). These are relevant for the olive growing part of the industry. Similarly, issues relevant to nurseries have been identified by the Nursery and Garden Industry Association as part of its development of the EcoHort guidelines and other materials.

3.2 Some European findings

The impacts presented above are consistent with overseas experience.

A life cycle assessment exercise in Europe (Technical University of Crete 2007) listed the following as activities for the production of olive oil affecting the environment:

- use of electricity
- irrigation
- fertiliser production, transport and application
- pesticide and herbicide production, transport and application
- soil management
- planting, cultivation and pruning of trees
- harvesting and transport of olives
- processing, including water use
- waste management
- oil storage.

The recommendations arising from that work emphasised the need for action, in particular on chemical use, soil erosion, energy and water use, and waste. The recommendations included implementation of an environmental management system as … the best “Good Practice”, that can be recommended (Technical University of Crete 2007).
A report produced for the European Commission by the European Forum on Nature Conservation and Pastoralism and the Asociación para el Análisis y Reforma de la Política Agro-rural (Beaufoy 2000) listed the following as the main areas of environmental impact for the industry in Spain, Italy, Greece and Portugal:

- soil
- water
- air
- biodiversity
- landscape
- energy use.

The study concluded that low-input traditional olive production has potentially the highest natural value (biodiversity and landscape) as well as the least negative effect on the environment. These plantations were also most vulnerable to abandonment.

More intensively managed olive production, including modern plantations of smaller tree varieties, were of least natural value and had the greatest negative environmental impact (in Europe, impacts were particularly on soil erosion, runoff, degradation of habitats and landscapes, and exploitation of water resources).

It cannot be inferred from this that there are exact parallels in Australia, but it does illustrate the point that differences in scale, management practices and location of groves and processing plants in Australia leads to the same general conclusions as in Europe – the issues and how they should best be dealt with will vary from place to place.

3.3 Some propositions to support action

The global changes described in Chapter 4 will affect the industry impacts, that is, the latter will change over time by location and in intensity. The effects will range from local (for example, shifts in pest and disease areas), to global (for example, rainfall reduction in some areas and agro-region boundary shifts). This again reinforces that any approach taken to deal with the impacts of the industry needs to be dynamic, grounded in industry practices and based on general propositions that can be readily translated into practical applications from place to place and time to time. These goals need to take into account the following assumptions derived from experience to date here and overseas as reflected in this report:

- expectations for environmental improvements will continue
- continuing increases in knowledge, the non-linear nature of global change, changes in resources available and changing expectations require a dynamic and improving system
- waste usually involves costs and losses
- those who work with the industry need to be involved
- whatever is done will contribute to the industry’s image.

The following propositions are suggested if high quality and productivity goals are to be met:

- the long-term goal should be continual reduction of impact on the environment
- zero-waste practices should be developed and adopted
- some degree of responsibility should be accepted for the environmental impacts for the whole life cycle of products
- staff, contractors and others in the supply chain should be involved in pursuit of industry environmental goals
- the industry should be, and be seen to be, a ‘good neighbour’.

3
It may also be possible to identify issues that should attract maximum effort, customising local efforts to fit conditions, resources and local pressures.

These issues might include:

- ensuring compliance with the law
- production based on natural systems, where possible – for example, integrated pest management
- reduced water use and dryland production
- retention and expansion of natural habitats
- efficient machinery use
- transition to renewable energy sources
- energy efficiency
- ‘green’ buildings and other infrastructure
- zero waste.

The weight given to these issues will vary from place to place and will be affected by operational styles and local factors for individual enterprises. An enterprise’s impacts on the environment and how they are dealt with will always be dependent on site-specific conditions.

To summarise:

- the industry has extensive environmental impacts
- knowledge of these impacts is essential for managing costs, food safety, Code of Practice obligations, biosecurity and for legal compliance
- international competitors are acting positively on similar impacts
- progressive goals for dealing with environmental impacts are desirable as part of the industry quality framework
- there are some industry-wide priorities for attention, with variation from place to place in respect of priorities and scope and nature of action.
4. The natural background

4.1 The industry and the environment

The olive industry is totally dependent on the natural environment. The location of olive groves and their productivity are directly related to climate conditions and water availability.

Research shows that the region in which the olives are grown is the most important factor for olive oil quality, yield and sensory characteristics. The regional differences are related to soil types, temperature, rainfall, day length, altitude and latitude. Annual seasonal variation is also an influence (Mailer and Ayton 2008).

Changes in climate, for example, from global warming, and in seasonal climate patterns will change the boundaries of relevant climate zones, affect the availability of water, and affect productivity and quality and, therefore, characteristics and profitability of products. This issue is elaborated in Cullen et al. (2010).

Processing, distribution and sales are dependent on successful olive growing and directly involve exploitation of natural resources, for example, for buildings, energy, packaging, promotional material, and waste assimilation.

The olive industry, therefore, is part of the natural system that determines what, when and how we act and react. Often some parts of the natural system are more prominent in the public mind than others, for example, climate change and water issues at the moment. Specific industry activities may be connected with some specific environmental issues, for example, processing with waste. These factors can lead to suggesting that each industry or environmental issue can be considered in isolation. The National Farmers’ Federation has pointed out (in the context of the draft Australia’s Biodiversity Conservation Strategy 2010-2020) that:

There can be a tendency to focus on particular ‘trendy’ environmental issues. In the late 1990s, it was dryland salinity as a major threat, and there was a lot of Government attention through planning and funding. A decade later, this issue is not even included in the current Caring for Our Country business plan.

The current ‘trendy’ environmental issues are climate change and acid sulphate soils (with a focus only on the Lower Lakes in South Australia). (NFF 2009)

The folly of fragmenting environmental effort has been highlighted by many researchers, for example, Hatfield-Dodds and Proctor (2008) and Martin and Warren (2009) in relation to financing environmental improvement; Canadell et al. (2007) in dealing with describing, analysing and responding to the global changes identified in recent decades; and Freudenberger and Stol (2002), illustrating how using ‘habitat farming’ in the interests of biodiversity protection is weakened by failing to include all environmental issues. Martin and Warren (2009) and Hatfield-Dodds and Proctor (2008) both also point out that favouring one element of the environment can lead to adverse affects for other parts of the environment. This conclusion is repeated on a global scale in The Economics of Ecosystems and Biodiversity (Sukhdev 2008), which was prepared to support effective implementation of the United Nations’ Convention on Biological Diversity, of which Australia is a member.

The need for a comprehensive approach, avoiding reductionism or concentration on a limited number of issues, increases the risk of losses from unexpected events and may lead to unforeseen diminution of resources for the future. As the Australian Treasury (2010) states:

The environment’s direct contribution to well being comes from the fact that it sustains life, provides health benefits and generates considerable enjoyment. We are also enriched simply by its existence. It is difficult to estimate the value of the environment’s direct contribution to well being, creating the risk that it will be undervalued and suffer damage.
See also the extract from the Villach Statement of 1985 (WMO 1986) on the atmosphere and climate in Section 4.3.

The inter-connectedness of environmental, economic and social issues is well illustrated in a recent report by defence analysts in the USA (US Joint Forces Command 2010). The commercial folly of responding to only one or a few currently prominent issues is illustrated by developments in overseas markets. The European Union has adopted a Sustainable Consumption and Production Action Plan and directives for Ecodesign and Energy Labelling. These involve comprehensive approaches to environment and commerce. In France, implementation of these had led to the following becoming law in 2009:

As from 1 January 2011 the consumer shall be informed by way of marking, labelling, presentation or any other appropriate means, of the carbon equivalent content of the products and their packaging as well as of the consumption of natural resources or the impact on the natural surroundings which are attributable to these products during their life cycle. Government decrees will specify the modalities and implementation conditions for each category of products and according to their mode of distribution. (Golden 2010)

Subsequent consultation by the General Commission for Sustainable Development has led to ‘great unanimity’ for the following set of environmental criteria to best describe the impact of food products on the environment:

- potential climate warming
- impacts on water via eutrophication and ecotoxicity
- impact on biodiversity
- no solid waste criteria (Golden 2010).

This and other European developments are inputs into the Sustainability Consortium processes supporting the Walmart initiatives (see elaboration in Chapter 5, Section 5.1).

The problems of trendiness and counter-productive reductionism can be countered by having regard to natural cycles and systems. These indicate the connections and interactions among environmental issues. Hydrology, carbon and nitrogen cycles and biodiversity all are relevant to the olive industry, and illustrate this point. Their inseparability and their links with human activities are captured by the concepts of global change and ecological footprints.

4.2 Natural systems

**Hydrological cycle** – The hydrological cycle describes the circulation of water through natural systems. Water is required for many of the complex chemical reactions affecting all life forms, including commercial crops. It transports nutrients and waste. In industry, including olive oil production, it is used for cleaning and other purposes.

Water is continuously circulating, moving constantly above, on and below the Earth’s surface. Movement of water occurs as a result of evapotranspiration from plants, precipitation such as rain and snow, surface runoff, sub-surface flow and evaporation. The following diagram illustrates this cycle.
Figure 1: The global water cycle

This schematic representation shows the evaporation of water from the oceans and land surface, its transport within the atmosphere, its condensation to form clouds and its return to Earth as precipitation (rain and snow) both over the oceans and over land where it may either run off to the ocean in rivers or percolate into the ground and eventually reach the ocean as groundwater flow. The fluxes are shown in units of $10^{12}$ m³/year and the storages in units of $10^{12}$ m³. (source: BOM undated)

It therefore follows that any diversion of water for industry purposes will have consequences for the hydrological cycle and the land surfaces, waterways, ecosystems and plants and animals in the affected watershed, that is, the entire area of land that ‘drains’ into a surface stream. Diversion of water for human use, directly or to support domestic plants and animals, will reduce that available for other plants and animals in the watershed. If it becomes polluted, it may have adverse effects for them and for other human uses.

As water circulates underground, in the atmosphere and in lakes and oceans, the impacts may extend well beyond the local area.

The design and management of infrastructure affects the hydrological cycle. For example, the use of hard stands and roads at processing plants increases the local proportion of impervious surfaces, so that the proportion of rainfall becoming surface runoff will increase. It will carry with it any pollutants from the hard surfaces, for example, from vehicles, so overall the potential for erosion, soil contamination and adverse impacts for local plants and animals is increased.

Individual interventions in the hydrological cycle may, by themselves, have only limited effects. Those effects will be magnified and may generate major problems as a result of an accumulation of the effects of many interventions in a watershed, e.g. the Murray-Darling Basin problems.

**Carbon cycle** – Carbon, like water, is an essential part of all living things. It exists in the non-living environment as carbon dioxide in the atmosphere and dissolved in water, in carbonate rocks, such as limestone and coral, as dead organic matter, and as deposits of coal, petroleum and natural gas derived from once-living things.

Carbon is taken in by plants through photosynthesis. It returns to the atmosphere and to water by respiration, burning and decay. The following diagram illustrates this.
Figure 2: The global carbon cycle

This schematic representation shows the global carbon reservoirs in gigatonnes of carbon (1 GtC = 10^{12} kg) and the annual fluxes and accumulation rates in GtC/year, calculated over the period 1990 to 1999. The values shown are approximate and considerable uncertainties exist as to some of the flow values. (source: BOM undated)

There are effectively two types of carbon cycle – that acting on relatively short time scales involving the natural cycles of living things (about twenty years), and that involving weathering and erosion of carbonate rocks and volcanic action over very long time scales.

There has been significant human intervention in carbon cycles, particularly over the last two hundred years or so through land clearing, land use changes and the extraction and burning of fossil fuels. The latter, our major source of energy, has led to changes in carbon pool balances, with carbon being taken out of otherwise locked away fossil deposits and ending up in other carbon pools, primarily the atmosphere and the ocean. As the atmosphere has historically been a small carbon pool, relatively small changes in the fossil pool can have relatively large impacts on the atmosphere.

The increase in greenhouse gas emissions since 1800 is roughly proportional to human population increases, and not surprisingly continues to increase. Human population is not expected to stabilise until at least 2050. So the industry should assume that changes in the carbon pool balance will continue at least until 2050, and longer to the extent that the pursuit of modern ‘industrialisation’ will continue after that. This means the industry should also assume that unpredictable and unexpected changes will continue well beyond the lifespan of all those currently involved in the industry.

The way land is managed within olive groves will affect the carbon cycle – practices involving no, or little, vegetation will lead to reduction in soil carbon, while other processes will increase it. Energy derived from fossil fuels will contribute to atmospheric and ocean carbon.

As with the water cycle, an individual action may have minimal impact, but accumulation of many small actions may have quite significant effects. This is illustrated by the global warming problem and the loss of 50–60 per cent of carbon from most farmed soils in Australia over the last two hundred years or so.

**Nitrogen cycle** – Nitrogen from the atmosphere is converted into a plant nutrient by lightning and bacteria. Nitrogen is then released back into the atmosphere though organic wastes. The following diagram portrays the cycle of nitrogen in its many forms within the environment.
A build up of nitrogen in the soil, e.g. from the use of fertilisers, can increase soil acidity with consequential effects on soil composition, plant life and productivity. Nitrous oxide is a greenhouse gas.

Human alteration of the nitrogen cycle, for example, from use of fossil fuel and nitrogenous fertilisers, has led to human-derived nitrogen exceeding that from natural processes in many parts of the world.

Increased nitrogen inputs may increase greenhouse gas concentrations, reduce other soil nutrients, reduce the density, biomass and diversity of native plants and facilitate and magnify weed growth (Virousek et al. 1997).

Runoff with added nitrogen from fertilisers causes water quality problems. Use of nitrogen fertilisers leads to higher nitrate levels in some foods and drinking water supplies. There has also been an increased consumption of processed foods containing nitrates. Recent research suggests that increasing prevalence of diseases such as Alzheimer’s disease and Parkinson’s disease are a consequence of this increased consumption of nitrates (de la Monte et al. 2009).

**Biodiversity** – All the natural cycles are linked by the concept of biodiversity, which, at its simplest, is the plurality of all living things and their habitats. It includes the different plants, animals and micro-organisms, the genes they contain and the ecosystems they form, e.g. rainforest, lake, desert, coral reef. Every species within an ecosystem has relationships with the other species in it, and with the soil, air and water in it. So affecting any part of it may have quite significant effects for the whole, and consequentially for the species in it and for its soil, air and water.

Human activities, including farming, manufacturing, and consumption of goods and services, affect the flows of energy and materials in the whole system, and so affect all the living things in it.

Biodiversity supports many human activities and provides benefits, for example:

- climate and weather influences
- hydrology influences and protection of water quality
- carbon sequestration and cycling
- soil formation and protection
• mitigation of erosion
• nutrient storage and recycling
• genetic resources
• recovery from unpredictable events
• food and fibre
• waste assimilation
• pest control
• pollination of crops and other vegetation
• amenity, such as visual aesthetics, recreation, tourism and cultural values.


For practical policy and management purposes, biodiversity is often considered in terms of composition, structure and function.

Composition describes the totality of the components of biodiversity in a given area, which may be an ecosystem or part of one (for example, habitat types, species in the area, and the variety of genes making up the heredity of the species).

Structure refers to the physical patterns occurring in an ecosystem or area, for example, size of habitats and structure of vegetation types. Every species is bound to the rest of the ecosystem in a unique manner, in processes involving consumption, competition and cooperation. This structure of biodiversity and the interactions within it affect the soil, water and air in an ecosystem or area.

The functions of biodiversity are the outcomes of the ecological and evolutionary processes in the ecosystem or area, producing the ecological goods and services mentioned above. These functions are one of the bases of the natural cycles already described.

The more complex an ecosystem, the more stable it is and so it can withstand shocks and disturbances better than simpler ones. Agricultural ecosystems are often good examples of simple, unstable ecosystems, requiring additional inputs (such as pest control, fertilisers, irrigation and weather mitigation) to sustain them. As European studies have indicated, low-input olive production involves less interference with natural systems than more intensively managed groves – the latter have greatest instability as well as greatest negative environmental impacts (see Chapter 3, Section 3.2).

It is this natural instability that makes imperative the development and continuing upgrading and implementation of biosecurity plans for the industry.

The quite direct relevance of biodiversity for olive growing is evident from pest problems. In some places olives planted closely in association with native forest may attract olive lace bug from the forest. The positive aspect is that protecting the biodiversity in and about a grove can attract the predators of some olive pests. In all cases, the establishment of an olive grove alters the local ecosystem and, hence, the biodiversity. In some cases the biodiversity impacts may go well beyond the grove. The spread of feral olives in some places is an example of this.
4.3 Global change

The entire Earth system is dynamic, interactive and vulnerable, constantly changing on long- and short-term time scales and, on occasion, in sharp shocks with ‘winners’ and ‘losers’. Human enterprises cannot escape these effects. We are just part of nature and depend on it.

All landscapes and the natural processes connected with them are a consequence of the impacts from geology, climate and human intervention. As all of these vary continuously, the Earth is not in physical equilibrium or a steady-state condition. Our environment at any given moment is the product of many continuous interactions involving the solar system, climate and weather, natural cycles such as those described above, and all living species, including humans.

The ice age concept illustrates the very long time scale changes. The exact causes are debated but the environmental effects are obviously dramatic, and with very long-term effects, e.g. changing landscapes, sea level changes and shifts in species’ habitat and ecosystem composition.

Volcanic eruptions, earthquakes, tsunamis and other ‘natural’ events, some of which are associated with tectonic plate movement, bring changes that may be local to global and short to long lived.

Global change is the combined effect of changes in atmospheric composition, land use, declining biodiversity and now, almost certainly, climate, as illustrated by the following extract from the introduction to the most recent major synthesis and analysis of global change research over the last decade or so:

The Earth System, including its terrestrial and marine ecosystems, is being altered as a result of human activities. These global changes have been well-documented (e.g., Vitousek et al. 1997; Mooney and Canadell 2001; Steffen et al. 2004). They include changes in the composition of the atmosphere, including increasing concentrations of greenhouse gases; changes in global and regional climate; habitat destruction and land cover change; increases in the amounts of reactive nitrogen compounds in the biosphere; increases in species extinction rates; and increases in the number and impacts of exotic invasive species. The extent and magnitude of human-caused changes had led Nobel laureate Paul Crutzen (2002) to propose that the Earth has entered a new geologic era, the Anthropocene – an era of human domination of the Earth System, in contrast to the previous billions of years of Earth’s history when natural forces dominated the Earth.

Nowhere are the impacts of human activities more apparent than in terrestrial ecosystems, with even the most remote and pristine terrestrial systems experiencing the effects of global change. The terrestrial portion of our planet obviously supplies many of the important ecosystem services upon which our society depends, including fresh water and much of our food and fiber. Because global change has the potential to significantly alter the structure and functioning of terrestrial ecosystems, considerable resources have been invested over the past decade on research to understand the effects of global change on ecosystems. In addition, since terrestrial systems are active components of a dynamic Earth System, research has also focused on whether those changes in terrestrial ecosystems are resulting in positive or negative feedbacks to the atmosphere and physical climate system. (Canadell et al. 2007)

This work provides synthesis and analysis of the large amount of research around the world on global change topics since the 1980s. The Overview in Appendix 2 from 1997 indicates that available evidence then suggested that substantial global changes were underway. The work referred to here confirms the earlier conclusions and indicates many areas of uncertainty where further research would be desirable.

Human impact on the environment has increased enormously as human population has grown. Industry, agriculture, extraction of natural resources, urban living and changing patterns of production and consumption all have environmental impacts. These impacts have been most significant over the last two hundred years or so, but humans have been having a significant impact at least since the advent of intensive agriculture and the establishment of towns and cities. In Victoria, where about half of Australia’s olive production comes from, the government has accepted global changes as the foundation for its land and biodiversity policy released in 2009, specifically citing climate change and
its causes, population increase and land use as the major causes of change (Victorian Department of Sustainability and Environment 2009).

The human impact has become increasingly important as human population has increased dramatically, approximately trebling since 1900, with consumption of natural resources increasing at an even greater rate.

**Climate change as an example** – Particular issues acquire prominence from time to time in this context, e.g. global warming at the moment (i.e. 2010). Global warming (or cooling) is a natural outcome of changing concentrations of greenhouse gases in the atmosphere.

This is in addition to the climate variations arising from changes in the Earth’s orbit and tilt, variations in solar output, changes in land and ocean floor topography affecting changes in ocean and atmospheric circulation patterns, and shorter-term impacts from natural events such as volcanoes.

As long ago as 1859 John Tyndall discovered that some colourless gases such as carbon dioxide and water vapour absorb some heat energy when exposed to radiant heat (Tyndall 1861). His 1861 paper predicted a relationship between concentration of these gases and climate. In 1904 Svante Arrhenius realised that the concentration of carbon dioxide in the atmosphere was increasing because of the burning of coal and this must eventually affect the Earth’s climate (Arrhenius 1906). By 1938 Guy Callendar had shown that the Earth’s temperature had increased, which he attributed to burning of fossil fuels (see for example Callendar 1938).

In the 1950s scientists started to inform the public that greenhouse gases might become a problem within the next few centuries, and that greenhouse gas emissions were rising. By the 1970s, an international research effort was underway exploring the many uncertainties surrounding greenhouse gas emissions and their impact on climate.

In 1979 a report prepared for the US Academy of Sciences by a group of eminent scientists included the following:

> For more than a century, we have been aware that changes in the composition of the atmosphere could affect its ability to trap the sun’s energy for our benefit. We now have incontrovertible evidence that the atmosphere is indeed changing and that we ourselves contribute to that change. Atmospheric concentrations of carbon dioxide are steadily increasing, and these changes are linked with man’s use of fossil fuels and exploitation of the land. Since carbon dioxide plays a significant role in the heat budget of the atmosphere, it is reasonable to suppose that continued increases would affect climate.

> These concerns have prompted a number of investigations of the implications of increasing carbon dioxide. Their consensus has been that increasing carbon dioxide will lead to a warmer Earth with a different distribution of climatic regimes. (Charney et al. 1979)

The increased research effort led to the Villach Statement from a United Nations Environment Programme/ World Meteorological Organization/ International Council for Science conference in 1985 emphasising that the available evidence suggested that the past would not provide a reliable guide to the future:

> The possible problem of a change in climate due to the emission of greenhouse gases should be considered as one of today’s most important long-term environmental problems. It should be considered in the context of other ongoing changes of our environment also caused by human activities, such as air pollution, acid rain and deforestation. Only in this way can we achieve a realistic integrated view of the interplay between the environment as a whole and the global society that is required for thoughtful consideration of options and policies for avoiding long-term adverse consequences. (WMO 1986)

Now there is no disagreement that concentrations of greenhouse gases in the atmosphere have increased over the last two hundred years or so, that is, since the time of the industrial revolution. These gases play a major role in absorbing long-wave radiation emitted by the Earth, thus maintaining temperatures high enough to sustain life on Earth. The concern related to climate change is that the
An indisputable increase in greenhouse gas concentrations will lead to meaningful increases in temperature leading to changes in the whole atmospheric circulation regime, with possible dramatic, unpredictable and undesirable impacts. This conclusion inexorably follows from the acceptance of many laws of physics and chemistry.

In Australia, the Bureau of Meteorology states that:

Australia and the globe are experiencing rapid climate change. Since the middle of the 20th century, Australian temperatures have, on average, risen by about 1°C with an increase in the frequency of heatwaves and a decrease in the numbers of frosts and cold days. Rainfall patterns have also changed – the northwest has seen an increase in rainfall over the last 50 years while much of eastern Australia and the far southwest have experienced a decline. (BOM Climate Change website, <http://www.bom.gov.au/climate/change/>)

Research so far suggests that over coming decades there will be rising temperatures, higher evaporation, reductions in rainfall and surface flows across much of the country, changes in the length and timing of growing seasons, increases in the frequency of storms and other extreme events, and changes in the spread and behaviour of weeds and pests (Preston and Jones 2006; Khan 2006; Cullen et al. 2010). The most recent (March 2010) Bureau of Meteorology–CSIRO assessment is included in Appendix 3.

It appears likely that food production in Tasmania may be affected less than on the mainland, but even so it is stated that the direction of change in Tasmania is clear: an increasing frequency and severity of extreme weather events, including droughts and storms; an increasing risk of coastal and riverine inundation; changes in day-night temperature ranges; changes in the distribution of agricultural pests and diseases; and increased temperature and wind stresses on land, livestock, crops and infrastructure (Harrington et al. 2008).

There is general acceptance by the scientific community of the basic propositions that human activities are changing natural systems, including in the atmosphere, that there is a stronger greenhouse effect, that there is a global warming trend, and that this affects climate and weather and other natural systems. The scientific community has, of course, also been at pains to point out that with the present state of knowledge many uncertainties remain.

Horticulture Australia Ltd has been investing in research it believes relevant to climate change and horticulture at least since 2003, but still concludes that:

Due to the diversity of the industry and the anticipated impacts climate change poses for horticultural businesses, the research responses that industry is and will need to continue to implement to manage and adapt to climate change are varied.

While there has been a significant amount of research already undertaken, there are still gaps in climate change research relevant to horticulture, and further investment is required.

To reduce the impact of climate change, it is imperative that management strategies be identified and implemented by horticulture to either offset negative impacts, or take advantage of positive responses (e.g. increased concentrations of atmospheric CO2 could benefit productivity of most horticultural crops).

It is also important to develop the capacity and knowledge so that growers can make effective business decisions, minimize risk, and manage our response to current climate variability more effectively. This will ensure both the long-term viability and sustainability of our industry, and continued availability to consumers of fresh and health-giving horticultural outputs. (HAL 2010)

Recent summaries of the present state of knowledge are in Appendix 3.
4.4 The future

Australia is subject to very high natural climate variability, symbolised by the relatively high frequency of droughts and, in some areas, floods. Australian farmers are used to coping with droughts. Now, however, the dynamics and variability of droughts seem to be different from those of the past, especially in the Murray-Darling Basin, the source of more than 60 per cent of Australia’s olives. Because of the non-linearity of global systems at the moment, it is not sensible to assume that a return to better seasons will be uniform in olive-growing areas, or be equivalent to past experience.

With existing knowledge it is not possible to predict with any degree of certainty how the ecosystems within which olive growing occurs will interact with continuing global changes. It would be unwise to assume that any problems can be ‘managed’ away even if they are identified in time.

Global changes therefore will have unpredictable consequences for olive growing. Greater awareness of these issues may provide a sound basis for building resilience and ecological sustainability into olive growing.

The New Rural Industries Australia alliance currently being established (2010), with the Australian Olive Association as a member, has already recognised the priority needed for research and action to deal with the uncertainties arising from environmental challenges such as climate change and biosecurity (Miller 2010).

4.5 Impacts on the industry

The availability of water for human settlements and agriculture has been an issue in Australia for many years. For example, in 1986 it was pointed out that:

*In the most heavily populated regions of south western and south eastern Australia surface waters are committed to a high degree and consequences of climate change are potentially most serious.* (Pittock and Nix 1986)

That is, it is a potentially major problem where most of the olives are growing. Analysis by the International Water Management Institute concludes that the Murray-Darling Basin is one of the few areas in the world that has already reached the point of physical water scarcity, i.e. ‘sources of water overused and overmanaged, leading to serious water scarcity downstream’ (quoted by the US Joint Forces Command 2010).

If current population projections hold, the demand for water for human settlements will have doubled in the period 1995–2050.

Potentially lower rainfall and greater diversion away from rural areas will affect natural cycles and biodiversity as well as reducing the amount of water available for agriculture and rural-based industries such as olive processing.

Olives have been identified as one of the crops having greater resilience to low water availability (Cullen et al. 2010). This does not mean, however, that the industry would remain viable with lower and more variable water availability. Other factors, such as quantity and quality of production, value of product and marketing would play a part in determining viability.

A case study on the Fleurieu Peninsula olive industry indicated that key risk areas for the industry are water supply, soil salinity, summer impacts and business profitability (James and Liddicoat 2008).

The potential range of impacts arising from these risks has been described as follows:

_Ancient evidence suggested that increased cost pressures associated with these impacts may force business failures of many marginal Fleurieu Peninsula olive businesses. This could lead to derelict groves or significant changes to grove management regimes. Some growers in the workshop also stated that they could not afford to harvest their crop below a minimum anticipated financial return. The ‘knock-on’ consequences include economic and social impacts._
increased compliance costs and location specific invasive species threat to remnant native vegetation. While adaptation strategies need to focus on water security, the potential invasive species threat from derelict or un-harvested groves warrants further attention. (Department of Water, Land and Biodiversity Conservation 2008)

Direct emissions from Australia have little impact on the global atmospheric changes and world climate. Many of the current impacts are from historic changes, and most current emissions are from only a few countries or regions – Europe, Russia, India, China, the USA and Brazil. Any action within the industry to reduce greenhouse gas emissions and to sequester carbon can, however, contribute to a national reduction effort strengthening the position of the Australian government in seeking to influence other countries to contribute to reducing greenhouse gas emissions. Australian per capita emissions are four times the world average, mainly from the use of coal as a power source.

Global change impacts at a local level can, in some cases, be directly countered by local action, such as reduction in water use and managing for biodiversity conservation and carbon-rich soils.

Another example is landscape management affecting rainfall patterns. In South Australia it has been established that replacing native heathland by cropland changes air flows, bringing 30 per cent less rain to the cropland and 10 per cent more to the heathlands (Chambers 1998).

4.6 Ecological footprint

‘Ecological footprint’ is the term used in recent years to represent the average amount of productive land and shallow sea required to provide a person with food, water, housing, energy, transport, waste disposal and the resources used in business and recreational activities. The ecological footprint for Australians is estimated to be 6.6 global hectares per person, three times the global average and well beyond the 1.8 global hectares per person that is estimated to be needed for the planet to regenerate on an annual basis. More extensive information on this topic is available from Environment Protection Authority Victoria at <http://www.epa.vic.gov.au/ecologicalfootprint/default.asp>.

It follows that the olive industry (as well as all others) has an interest in reducing its contribution to Australia’s ecological footprint.

4.7 Differences within industry

The task is to ensure that the extensive and complex interaction between the industry and the environment is benign rather than harmful in respect of natural cycles and systems and particular aspects of the environment.

It is not feasible to be prescriptive about required practices and approaches for all enterprises in Australia, as there are substantial differences in circumstances among the many enterprises, for example, in respect of soils, hydrology, climate, management approaches, scale of operations, and regulatory regimes. European experience reinforces this point – see Chapter 3, Section 3.2. The Guidelines for Environmental Assurance in Australian Horticulture (Lovell 2006) make similar points. Even in the more uniform irrigated rice industry, expert advice has been that ... it is impractical to provide environmental targets and guidelines to all rice growers at once (Freudenberger and Stol 2002).

These conclusions about the inevitability of differences and the need to recognise and accommodate them mirror those of the Productivity Commission (2004) and the Commonwealth Government’s response to it (Australian Treasury 2004).

The issues will also change over time, because of developments within the industry, public expectations and changing environmental conditions. The intention is rather to establish principles and approaches that can provide a sound basis for developing, implementing and continually improving good environmental management contributing to better overall enterprise outcomes.
The level of uncertainty about many issues and the desirability of consistency of approach across the industry while respecting the differences reinforce the value of using a formal management system as the framework for action.

To summarise:

- the olive industry involves intervention in the environment, and is dependent on natural systems
- agricultural systems are inherently unstable, reinforcing the need for biosecurity programs
- comprehensive action on environmental aspects rather than concentration on one or a few is necessary to reduce commercial risks
- natural cycles and ecosystems vary from place to place and time to time
- these cycles and systems are undergoing non-linear and unpredictable changes that will affect the olive industry – its location, its production, and its markets
- adaptation to changing climate and other global changes is needed
- local action responding to elements of global change may reduce their impacts on olive enterprises in some circumstances and places
- no simple prescriptive approach will work for the whole industry because of the great diversity within the industry and the continually changing circumstances in which it operates
- use of a formal management framework can accommodate diversity and uncertainty while facilitating industry-wide analysis and action.
5. Linking environment and business

5.1 Some key links

It is reasonable to assume that the most positive way to foster better environmental management and outcomes is to align environmental issues with other management requirements (addressed in Chapter 6) and to use better environmental management to respond positively rather than reactively to pressures on the industry. Prominent among these pressures are the law and associated regulation, costs, natural forces (symbolised by global change over the long term and water issues periodically), market forces, neighbourhood expectations and the industry’s voluntary Code of Practice.

Law and regulation – Everyone is expected to obey the law and conform to associated administrative and regulatory systems. The laws can vary from quite precise requirements through establishment of systems for decision making to statements of principle underlying the law.

Examples of laws with quite clear requirements include those relating to matters such as chemical management, quarantine, water management and noxious weeds.

Laws involving administrative action for their effects on an enterprise include land use controls and enterprise approvals. The law/environment connection is well illustrated by the development application process in New South Wales, which affects larger horticultural enterprises. The process requires attention to water, riparian management, native vegetation, threatened species and prevention of pollution. Usually, environmental assessments are required (NSW Department of Planning and NSW Department of Primary Industries 2006).

In South Australia the Guide for Applicants for Olive Processing requires that information provided to support an application should aim to ensure that, among other things:

- all potential environmental impacts are identified, including off site impacts on the neighbouring environment, such as noise, dust, fumes, water, odour, waste, etc.; (Planning SA 2001)

The application must set out:

- any action you propose to take to minimise impacts on the environment is clearly explained and documented. (Planning SA 2001)

There are also laws of a more general character, such as for an environmental duty of care. In Queensland, the Environmental Protection Act 1994 includes a ‘general environmental duty’ – Section 319 defines this duty as:

> A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm.

The Queensland Government’s list of possible types of environmental harm (Department of Environment and Resource Management 2009) includes:

- land degradation (e.g. soil erosion and decline in soil structure)
- air pollution
- water pollution (including pollution by salt, agricultural chemicals and nutrients)
- invasion of weeds and pests
- noise
- destruction of ecosystems and habitats
- loss of species
- harm to areas of indigenous cultural heritage.
All of these could apply in an olive industry operation.

The Queensland legislation (Department of Environment and Resource Management 2009) states that the three basic components of duty of care are:

- sustainable use of natural resources
- conservation of biological diversity
- avoidance of harm to indigenous cultural heritage.

These are sensible pointers to approaches that should be evident in olive industry management.

In South Australia the Soil Conservation and Landcare Act requires landowners ... to take all reasonable steps to prevent degradation of the land (Section 9). Section 20 of the Victorian Catchment and Land Protection Act requires landowners to:

- avoid causing or contributing to land degradation which causes or may cause damage to land of another land owner; and
- conserve soil; and
- protect water resources; and
- eradicate regionally prohibited weeds; and
- prevent the growth and spread of regionally controlled weeds; and
- prevent the spread of, and as far as possible eradicate, established pest animals,

and take all reasonable steps to prevent the spread of regionally controlled weeds and established pest animals on a roadside that adjoins the land owner’s land.

The even more broadly defined precautionary principle is included in legislation in all jurisdictions in Australia except the Northern Territory, where a 2009 Discussion Paper advocates its use in applying the ecologically sustainable development concept enshrined in its legislation (NT Environment Protection Authority 2009).

The Commonwealth Environment Protection and Biodiversity Conservation Act 1991 includes the following definition of the principle:

*The precautionary principle is that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage.*

This formulation is similar to those in over fifty international treaties. Formulations such as this are often criticised as negative and placing an undue emphasis on risk avoidance, and provide no guidance for day-to-day action.

The principle can, however, be couched positively in propositions that, if used in enterprises, support good environmental management. These include:

- basing decisions on preferred futures
- seeking the least risk pathways to the preferred futures
- consciously considering the potential environmental impact of the options available to achieve the preferred futures
- accepting responsibility for any unforeseen outcomes.

The immediate significance of the principle is that it can provide a platform for building a resilient business through least-risk approaches to many issues, with attendant environmental benefits, and an increase in predictability about many of the operations of a business and greater confidence in the community that the business will accept responsibility for its actions.
There is an obligation to act in accordance with the law, and advantages in using the principle positively, for example, to minimise direct regulatory intervention, in maintaining awareness of developing changes and using the principles underlying it as the basis for management systems in the olive industry. Anticipating and working with changes in law and its administration can avoid misplaced investment, simplify compliance, spread implementation and investment over a long period, and contribute to a positive public image.

Applying the principle positively helps overcome problems of uncertainty about the future, particularly important in an industry like olives where a grove and associated processing operations are expected to be long-lived and where there is reliance on natural resources. The Australian Treasury points out:

*The challenge for each generation is making choices now about the use of the stock of resources without knowing what knowledge and technological advancements will be available to future generations.* (Australian Treasury 2010)

Responses to global changes illustrate the precautionary principle at work in a practical way. There is certainty that global changes are occurring with regional and local effects and there is certainty that there are risks from the changes occurring. The precautionary approach is reflected in the research efforts to reduce the uncertainties about the future and in designing policies and practices designed to reduce risks and ameliorate potentially harmful consequences – *it is better to be roughly right in time than to be perfectly right too late.*

A ‘regulation risk’ for an industry is that governments will conclude that prescriptive regulation is the best option for achieving desired environmental outcomes, or for speeding up positive developments. The Queensland Government has already done this by passing an Act to control certain farming practices affecting the Great Barrier Reef, *Because the voluntary approach by farmers and graziers to the adoption of ‘reef friendly’ management practice is too slow to reverse the decline in the reef’s health ...* (Department of Environment and Resource Management 2010)

Primary producers, and others working in the industry, report that environmental law is more important for them than any area of law other than that relating to finance (Coverdale 2009).

**Costs** – Any environmental policy based on current issues will embrace greater efficiency of natural resource and machinery use, avoidance of pollution from fertilisers, machinery and vehicles, minimal packaging and avoidance of waste.

Dealing effectively with these issues will invariably reduce enterprise costs, and may increase revenue, for example, by transforming ‘waste’ into saleable or locally useable products.

The global changes canvassed in this report have negative cost impacts, as the supplies of traditional inputs such as oil and natural fertilisers are declining. Their cost can be expected to increase. Strategies to reduce industry dependence on increasingly costly and declining resources will obviously benefit it.

**Stock exchange requirements** – Australian stock exchange rules now require listed companies to report on their risk management practices, including environment (ASX Corporate Governance Council 2007; Deloitte, Blakiston & Crabb and ASX Market Supervision 2009).

**Natural forces and policy responses** – As indicated in Chapter 4, global changes will have an impact on industry operations, and arguably this is already occurring. There are implications for olive growing, product quality, the scale and location of olive processing operations, product logistics, and location and confidence of markets. Australia also has a highly variable climate, with the same implications.

Impacts of global changes will continue to occur for the foreseeable future, as their underlying causes continue, for example, global human population continues to increase as does the use of fossil fuels. So far, most jurisdictions around the world have been ineffectual in dealing with the causes. In Australia, the drought conditions over the last decade have led to severe water problems for
agriculture and human settlements. If current projections for Australian population growth are accurate, (62 per cent increase by 2050 – 96 per cent higher than when the modern industry effectively began in the mid 1990s), current problems will be greatly exacerbated even without droughts and climate changes.

The pressure for change will come from policy responses to the natural forces as well as from the forces themselves, for example, from systems to incorporate environmental ‘costs’ in prices, such as a carbon tax. There may also be policy responses positive for the industry, for example, incentive systems to encourage more environmentally friendly behaviour. The relationships among global change, policy issues, agriculture and food production are increasingly under notice, with an emphasis on ‘ecological modernisation’ (Heasman and Lang 2006). This work is having an influence in Australia (Richards and Lawrence 2008).

There are therefore practical day-to-day management, production and sales benefits in developing and using techniques and systems that provide maximum forewarning of short and long-term changes in natural systems and policy responses to them. As with the costs issues, the outcomes will include more rather than less activity sympathetic to environmental considerations.

**Supply chain and consumer expectations** – A substantial proportion of Australian olive product is sold in the two major supermarket chains – Woolworths and Coles (part of Wesfarmers). Both have sustainability programs. The Woolworths Ltd Sustainability Strategy applies directly to its operations, but it foreshadows developments affecting suppliers. Woolworths is:

... developing policies and procedures that ensure rigorous checks and balances for our suppliers, and will be working with non-government organisations and supply chain experts to provide independent advice and auditing of our processes (in respect of private label products with environmental claims). (Woolworths Ltd 2007)

Wesfarmers’ sustainability principles include:

Maintaining and enhancing the physical environment in which we operate including strategies to minimise our carbon emissions, improve water and energy efficiencies and minimise our commercial by-products and waste. (Wesfarmers undated)

Wesfarmers is a signatory to the National Packaging Covenant, a national scheme seeking to reduce the environmental effects of packaging on the environment. As part of ColesPLUS (Coles Product Lifecycle Use System) suppliers are expected to guarantee that packaging conforms to the Environmental Code of Practice for Packaging, which requires producers to document the rationale employed when designing packaging. Wesfarmers is also committed to the pursuit of continuous improvement outcomes in all its operations.

No doubt these retailer approaches are driven in part by judgements about consumer expectations.

Walmart, the world’s biggest retailer, announced in January 2008 that it was working on creating common social and environmental standards for suppliers. The intention was that all of its suppliers would be required to meet specific environmental standards, with compliance with the standards part of its contracts (Walmart Corporate 2008).

This led to the release of fifteen supplier sustainability questions by Walmart on 16 July 2009, based on its commitment to being supplied 100 per cent by renewable energy, creating zero waste and selling products that sustain people and the environment. The questions relate to energy and climate, material efficiency, nature and resources, and people and community (Walmart Corporate 2009a). The list of questions is in Appendix 4.

One of the questions relates to third-party certification.

Walmart is proposing to develop a Sustainability Index for every product it sells. A Walmart executive suggested that the use of the Index ... will be a way of making a final decision beyond cost (Schwartz
2009). The Sustainability Index will be based on life cycle analysis, with background work for this being done by a Sustainability Consortium. The Consortium is

... an independent organization of diverse global participants who work collaboratively to build a scientific foundation that drives innovation to improve consumer product sustainability through all stages of a product's life cycle.

and its mission is

To develop and promote science and integrated tools that improve informed decision making for product sustainability throughout the life cycle while serving the needs of members. (The Sustainability Consortium 2009–2011)

It is jointly administered by the Arizona State University and the University of Arkansas. Major companies involved in this work and operating in Australia include Cargill, General Mills, Monsanto, Tetra Pak and Unilever.

A Walmart subsidiary in Britain, ASDA, already applies a selection of environmental criteria in selecting several of its products (Your Asda undated). The industry needs to be well positioned to keep up with, and act in anticipation of, these changing preferences and supplier requirements based on environmental issues.

These individual actions are consistent with wider and potentially more pervasive developments supporting greater attention to the whole-of-life environmental impacts of products reflected in world-wide economic developments (World Economic Forum 2010). The World Economic Forum (2010) suggests that sustainability action by businesses is important for the following reasons:

- **Managing resource risks**: Sustainability matters to business because it reduces exposure to volatile and rising resource prices, to the risk of increased scarcity of resources and to the risk that these (carbon, water, waste) are radically re-priced in the near future. Embracing models of sustainable consumption across the value chain will provide stronger resilience against external shocks.

- **Shaping the regulatory environment**: Principles of sustainability are increasingly being incorporated into the regulatory environment. If businesses wish to flourish in this environment, they must make themselves active participants in its construction.

- **Engaging consumers as citizens**: The biggest drivers of corporate sustainability investments are consumer concerns, employee interest and government legislation. For business, driving sustainable consumption can be an effective long-term strategy for deepening authentic engagement with consumers and employees.

- **Engaging consumers as customers**: Consumers increasingly want to be treated as customers, demanding not only more sustainable products and services, but also greater transparency over sourcing and content of existing ones. At the same time, the speed, spread and changing patterns of use of the media are forcing businesses to adopt pre-emptive strategies to manage their reputational risk on sustainability issues. Engaging proactively with the sustainable consumption is one of way of managing these challenges in depth.

- **Capturing opportunity**: In the end, sustainable consumption matters to business because there will be winners and losers in the new economy, and those that move most swiftly are likely to reap the greatest benefits. Embracing sustainable consumption now offers a pathway to future markets and profitability.

Several major international food industry companies are directly and actively involved in these World Economic Forum activities.
**International competitiveness** – There is additional market pressure from the increasing attention paid to environmental issues in Europe. The European Commission has supported detailed studies of industry environment issues, for example:

- the life cycle assessment for olive oil production in 2004-6
- the report produced by the European Forum on Nature Conservation and Pastoralism and the Asociación para el Análisis y Reforma de la Política Agro-rural on practical options for improving the environmental impact of olive oil production in the European Union
- the review of olive processing waste management, first published in 2004 with a revised, updated issue in 2006 (Niaounakis and Halvadakis 2006)
- the collaborative research work on an *Integrated Approach to Sustainable Olive Oil and Table Olives Production*, aimed at developing Environmental Quality Standards for the industry
- the many other environmental research projects supported by the European Commission under its LIFE program, covering many facets of olive cultivation and olive oil production (European Commission 2010).

A 2006 analysis of the competitiveness of the European industry included environmental problems (pollution, soil degradation and erosion, interference with high value ecosystems, over-exploitation of water) as a weakness.

Clearly it is in Australia’s interest to develop and maintain an advantage in environmental management as part of its competitive armoury. Otherwise the Australian industry will be in a reactive and ‘catch up’ position, instead of leadership position (P Wensley, Governor of Queensland 2009).

**Neighbourhood expectations** – The industry does not operate in a vacuum. Each part of its operations will have near neighbours and will be part of a wider community. Sympathetic attention to issues such as noise, dust, pollution, interference with public amenity, landscape management and impact on local or regional hydrology will improve the industry’s public image.

Olive enterprises can contribute to the social and economic wellbeing of their local communities. Research in other, longer established industries, such as cotton (Lux 2009), indicates that these effects differ from place to place, but that there is little knowledge of the detail of the interactions. Maintaining a stable industry by superior risk management, including for the environment, will obviously support rather than detract from, community well-being.

**Health and safety** – In every jurisdiction there are laws mandating safe workplace practices. Good employment relationships require attention to staff and visitor well-being regardless of legal obligations. Many industry activities affecting the environment also have health and safety implications, such as chemical storage and use (including fertilisers), maintenance and use of machinery and tools, waste management and building cleanliness. Better management of these issues can reduce costs and risks and improve enterprise image with staff, contractors, service providers and visitors.

**Code of Practice** – The industry’s voluntary Code of Practice requires signatories to operate an environmental management system involving continual improvement and attention to biodiversity. It therefore provides a comprehensive framework for response to the pressures on the industry.

**Biosecurity** – The Industry Biosecurity Plan requires attention to avoiding pest and disease problems and hence is part of environmental management.
5.2 Adaptability and resilience

Although the pressures on the industry are easily enough described in general terms, in each case the effects for different enterprises will be different and there are many unknowns.

Identifying, assessing and managing risk is a common business practice. Including environmental issues as part of risk management increases the prospects of achieving holistic, whole-of-enterprise outcomes.

Adaptability and resilience are important because of the many uncertainties about issues affecting the industry, including relation to the environment. Adaptability involves the capacity to identify, understand and act on new circumstances so that the outcomes are more rather than less positive. Opportunities can be taken and not missed. Resilience involves absorbing shocks without changing the essential function or operation. This means that an enterprise needs to be able to cope with novel situations without losing options for successful continuation. Participants in a Paddock to Plate workshop in Victoria concluded that flexibility, localised solutions and leadership, strong networks and links, and diversity are contributors to resilience (Campbell 2009).

This emphasis on adaptability and resilience is a feature of the Horticulture Climate Change Action Plan (HAL 2009), and of the submission from the New Rural Industries Australia alliance to the Productivity Commission’s inquiry on Rural Research and Development Corporations (Miller 2010).

The need for effective adaptation strategies is a recurring theme of a South Australian assessment of key natural resource management sectors that are vulnerable to climate change. One premise in the assessment is that perennial horticulture systems are among the most vulnerable systems (Bardsley and Sweeney 2008).

Recognising and acting on the links between pressures on business and environmental issues is a factor in adequate risk management and in developing and acting on the adaptive capacity desirable for maintaining a resilient enterprise.

Many current enterprises used scenarios prepared in the 1990s. The financial and other assumptions underlying those scenarios and sensitivity analyses presumably no longer hold. An adaptable approach requires that such analyses are continually updated and that analyses based on possible future global changes are undertaken. This would facilitate sounder business decision making in the industry.

To summarise:

- there is a need for positive action on environmental management because of pressures on the industry such as law and regulation, increasing costs, natural forces, market forces, neighbourhood expectations, health and safety obligations, the industry’s voluntary Code of Practice and biosecurity
- some existing obligations provide a basis for progressive industry programs
- adaptive capacity, resilience and effective risk management for the industry will depend on action on environmental management.
6. Systems and tools

6.1 Systems

The 2004 RIRDC report 04/057 recommended the use of environmental management systems based on ISO 14001 for all parts of the industry. The justification for this was:

Since 1996 there has been an internationally accepted standard for environmental management systems, subscribed to by Australia and New Zealand (ISO 14001). As it is comprehensive in scope, and as there are obvious benefits in aligning practices here with those in use in trading partners and competing industries and countries, it provides the best foundation for developing systems in Australia. The full ISO 14001 approach leads to certified and audited systems. Even if enterprises do not want to go that far, its elements are relevant to all.

and

It is possible to tailor the ISO 14001 approach to many different situations, so that it is implemented and maintained in such a way that achievement of environmental goals best suited to the type and scale of activity is promoted inherently, with minimal or no additional resource requirements. This is particularly important for the olive industry, as there are great differences in scale from very small to very large in the case of growers and processors. (Quinn 2004)

Over recent years the Commonwealth Government has invested in pilots and trials on environmental management systems, following development of the National Framework for Environmental Management Systems (EMS) in Agriculture. The Framework was based on ISO 14001.

A RIRDC report published in February 2009 (Quinn 2009) provided a stock-take of the position at the end of the pilots and trials. Because of the relevance to the current report the Executive Summary from that report is reproduced in Appendix 5.

Two particularly important conclusions for the industry from that report are that any system needs to be internationally credible (Hassall and Associates) and that ‘a certified and recognised, national system’ is needed (Elders).

A second RIRDC report on environmental management systems (Rowland 2009) points out that:

The research has . . . shown that rather than an envisaged national EMS based on the ISO 14001 international standard, many approaches are being adopted as EMS in Australia. This highlights the need to keep as a priority, establishing mechanisms for improved coordination and communication across and between groups working on environmental management. This can best be achieved by developing a voluntary but more internationally credible national certification system of EMS in Australia.

Rowland (2009) concluded that:

... there are several outstanding examples of agricultural projects where the rigour of the international standard ISO 14001 has been successfully married to flexible and practical approaches to managing information for landholders at the catchment scale. Examples are the Australian Landcare Management System (ALMS), the Western Australian Best Farms project and GippsBeef Lamb and Beef project.

This Australian support for using the international standard as the foundation is consistent with the conclusion in World Economic Forum discussions in January 2010 on the desirability of establishing ISO standards and labels for the environmental impact of consumer goods... (World Economic Forum 2010).

The only one of these of general and national application is the Australian Landcare Management System (ALMS) approach (now called the Australian Land Management Certification System or
ALMCS). An outline of this approach is in Appendix 6, and the description of it from Rowland (2009) is in Appendix 7.

Roundtables organised by Australia 21 (a non-profit company whose core business is research and development on issues of strategic importance to Australia in the 21st century) concluded that the ecosystem health and resilience fundamental for withstanding the shocks of change and for adapting to changing situations, such as climate change, global markets or oil depletion can be best assured by a voluntary national EMS certification system that will have national and international credibility (Rowland et al. 2005).

As indicated in Chapter 3, Section 3.2, studies in Europe led to the conclusion that the best ‘Good Practice’ that can be recommended for the olive industry is implementation of an environmental management system. The wisdom of the uniform certified system approach based on ISO 14001 is well illustrated by the difficulties where this has not been done.

In horticulture generally the recommended national internationally credible approach has not been taken. There are several systems, for example, Growcom Farm Management System, Farmcare Code, Enviroveg, the Australian Wine Industry Stewardship, EntWine Australia and the Freshcare Environmental Code of Practice.

The Freshcare Code has the most general application, but does not align directly with ISO 14001, although Freshcare Ltd states that ISO 14001 was ‘referenced’ in determining the practices for the Code. Freshcare Ltd states that it is ... an industry owned, not for profit on-farm assurance program, established and maintained to service the Australian fresh product industry (Freshcare undated).

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The fragmentation and confusion caused by the development of several different arrangements not embedded in the international standard has been recognised already in industries and by the Commonwealth Government. The latter, through the Caring for our Country program, is providing funds for a project ... to establish benchmark criteria for environmental systems in the Australian horticulture industry. It is stated that, Central to the project is a desire to ensure that primary producers are not burdened with different environmental assurance programs to satisfy different retailers or buyers.

It is not clear what the outcomes of this project will be, but it appears that the basis will be a very complex variation on some environmental aspects of product quality rather than an environmental management system and environmental outcomes as contemplated by the international standard.

The distinction between environmental assurance and environmental management systems is important. To quote Horticulture Australia Ltd (Lovell 2006):

Environmental assurance provides a generic checklist of recognised environmental best practices. An Environmental Management System, or EMS, describes any systematic approach to managing the impacts an enterprise has on the environment. EMS is one of the tools available to help a business deliver environmental assurance.

EMS provides a process for the business to keep track of all the information needed to demonstrate to both business managers and external parties it is meeting the environmental assurance standard established. A business would not necessarily need a comprehensive EMS in place to demonstrate compliance with the environmental assurance standard.

Achieving the present state of confusion and fragmentation in horticulture generally has taken several years and considerable investment. The olive industry could avoid confusion and delays and costs by the use of an existing system that is:

- internationally credible, that is, is based on ISO 14001
- a certification system
- applicable to multi-activity enterprises
- applicable to all aspects of the industry
• able to be customised to suit the circumstances of different enterprises in different places
• able to link-in simply with neighbouring activities and priorities.

Using an existing system with its own public engagement approaches takes advantage of the latter, avoids new investment in developing industry specific arrangements, and provides a basis for simple, not complex, messages to consumers.

6.2 Identifying the environmental impacts

The industry can maximise its credibility on environmental issues by demonstrating that it is aware of, and willing to act on, the industry’s impact of the whole life cycle of its products. An increasingly used way to do this is by using life cycle assessments. A life cycle assessment is a framework for systematically identifying, understanding and quantifying the environmental impacts of a product or service throughout its life, from acquisition of raw materials to final disposal – ‘cradle to grave’.

The outcomes of a life cycle assessment can contribute to holistic approaches to enterprise management, provide the information necessary to respond to pressures from outside interests on specific issues, such as carbon and water footprints, that are bound to change from time to time and place to place, and can simplify the development and maintenance of enterprise management systems.

The steps in undertaking a life cycle assessment include:

**Establishing goal and purpose** – in this case, a foundation for pursuing improved environmental outcomes, including monitoring and reporting (in other cases it might be to support marketing or comparisons with other products)

**Product or functional unit definition** – for example, a 500 ml bottle of olive oil, or whatever the relevant product is from an enterprise

**System boundary** – this determines which elements of the process will be included in the study. Otherwise the process becomes endless, for example, where road transport is involved, it should not be necessary to include materials for various small truck parts. The industry flow charts and boundaries criteria used in the Ecoil project in Europe (see Technical University of Crete 2007 for information on the project) are reproduced in Appendix 8. Arguably a complete life cycle assessment for a food product should cover agricultural production, processing, storage and distribution, packaging, sales and consumption and management of final waste. The European study covered only the agriculture and processing stages

**Data collection and inventory analysis** – primary data should be collected directly from the participants in the industry. Secondary data, such as emissions arising from use of national grid power, can be derived from published or similar sources

**Impact assessment** – the aim is to understand and evaluate the magnitude and significance of the environmental impacts

**Interpretation and reporting** – the setting out of conclusions and recommendations, with whatever qualifications (such as inadequate data) are desirable.

The assessment should comply with ISO 14040 for consistency with others and for maximum credibility.

The Ecoil results illustrate the value of such assessments. They highlighted the differences among the selected sites (in Greece, Cyprus and Spain), pointed to potential financial gains and helped establish priorities for action, for example, in Greece, reduction of the use of fertilisers and pesticides and better management of pruning and processing waste.

As in the European case, life cycle assessment would need to recognise the differences across Australia, for example, by reference to agro-ecological region.
RIRDC Report 09/028, *Life Cycle Assessment Methodology for Australian Rural Industries* (Harris and Narayanaswamy 2009), is a first attempt at setting out life cycle assessment for energy and water use and greenhouse gas emissions in agriculture in Australia.

Identifying impacts can also be assisted by using available computer software, for example, myEMS, (www.myems.com.au) a web-based software tool for use in the development, maintenance and auditing of environmental management systems based on ISO 14001. It contains default information on impacts for many farming activities. This, in turn, simplifies the use of environmental management systems for all activities at a location, for example, combined livestock/olive operations.

### 6.3 Assessing priorities

Application of risk assessment techniques can assist in establishing the seriousness with which an impact should be treated and in establishing priorities. The risk from an activity that can have negative environmental impacts is a function of the likelihood of the problem arising (for example, an oil spill) and the magnitude of its impact (for example, the impact of an oil spill is greater in the habitat of a threatened species than in a bunded shed).

Using risk assessment techniques helps avoid the perils of reductionism, too much attention to too few issues or too little attention to a small, but potentially increasingly significant issue. A comprehensive approach allows meaningful comparison of all identified risk, assessment of the consequences for others, sometimes even remotely distant from the enterprise, can indicate relationships among risks and facilitates identification of priorities (Cocks 1992).

Table 3 is an example of a risk assessment rating table for an imaginary irrigated olive grove.

**Table 3: Risk assessment for an imaginary irrigated olive grove**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Impact on environment</th>
<th>Impact on costs</th>
<th>Impact on continuity</th>
<th>Impact on image</th>
<th>Regulatory issue</th>
<th>Priority for attention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>1</td>
</tr>
<tr>
<td>Soil and inter-row management</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>3</td>
</tr>
<tr>
<td>Weed control</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>2</td>
</tr>
<tr>
<td>Fertilisers</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>3</td>
</tr>
<tr>
<td>Machinery and energy</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>1</td>
</tr>
<tr>
<td>Herbicides</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>1</td>
</tr>
<tr>
<td>Harvesting</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>2</td>
</tr>
<tr>
<td>Buildings</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>3</td>
</tr>
</tbody>
</table>

● = high  ● = medium  ● = low

On the basis of this assessment, the highest priorities for work on reducing impacts would be in respect of irrigation, machinery and energy use, and herbicides. In reality, as irrigated olive growing involves considerable intervention in natural systems, continuity of business will involve continuing relatively high impacts. This would mean achieving the highest possible irrigation efficiency as a priority environmental goal.

Where the level of risk is assessed as significant, decisions can be made on the most appropriate action to take, for example:
1. **transfer the risk** – such as use of contractors or insurance, noting that the enterprise will still be accountable for the outcomes

2. **reduce the risk** – by changing practices

3. **accept the risk** – building in monitoring and contingency plans to deal with the situation should it arise.

A different enterprise, for example, a dryland or organic grove, would have quite different outcomes.

Any olive enterprise that is part of a company listed on the Australian Stock Exchange must undertake risk assessments and report on them, as part of its compliance with the Exchange’s *Corporate Governance Principles and Recommendations*. The business risks involved include environmental and others related to the environment – sustainability, product quality, and market-related risk (Deloitte, Blakiston & Crabb and ASX Market Supervision 2009).

### 6.4 Extended producer responsibility

Extended producer responsibility is where a producer positively manages the environmental impacts of a product throughout its life cycle. The producer takes responsibility for the product to the post-consumer stage, and may bear responsibility to some degree for all environmental impacts of his or her products. One of the first formal programs illustrates the process. A German program was introduced in 1991 through a Packaging Ordinance that held producers responsible for managing packaging waste. About thirty countries now have packaging take-back laws.

The OECD has endorsed principles for extended producer responsibility (see Appendix 9). In Canada the purpose of this approach is stated as follows:

> The overarching goals of the principles are to minimize environmental impacts, maximize environmental benefits, promote the transfer of end-of-life responsibility for the product and/or material to the producer, and encourage design for environment (DfE). Design for environment (DfE) examines a product’s entire lifecycle and proposes changes to how a product is designed in order to minimise its environmental footprint. Incorporating DfE may contribute to natural resource and energy conservation, biodiversity preservation, source reduction, waste minimisation and pollution prevention. (CCME 2007)

Use of this approach can support several business objectives – legal compliance, cost reduction, marketing, international competitiveness, being a good neighbour.

### 6.5 Action programs

There are several approaches (sometimes supported by government incentives programs) that can contribute positively to pursuit of better environmental outcomes.

**Cleaner production** – The Queensland Environment Protection Agency defines cleaner production as:

> ... the continual effort to prevent pollution; reduce the use of energy, water and material resources; and minimise waste in the production process. It involves rethinking products, product components and production processes to achieve sustainable production.

It states that cleaner production involves:

- processes designed for minimum waste
- maximum use of by-products
- savings through reduced pollution control technology, and reduced waste treatment, transport and disposal
- minimum impact on the environment.
The claimed business benefits include reduced costs, value from by-products, reduced regulatory burden, less risk of liability for environmental problems, improved occupational health and safety and improved image.

Cleaner production involves use of the precautionary principle in the way proposed in this report (a positive approach pursuing the least risk pathways to preferred futures) and fits well with use of lifecycle assessment.

**Zero waste** – The RIRDC report that was the precursor to this report (Quinn 2004) proposed the adoption by the industry of the principle of zero waste, taking account of the deliberations of a workshop on processing waste in Victoria in 2004, organised by the Strathbogie-Goulburn Olive Growers Association. In practical terms, a zero-waste approach means that all by-products of a process (except for any that are regulated by specific laws, such as defined hazardous substances):

- are returned to a benign condition (for example, treated water)
- are re-used or recycled
- become a new product (for example, compost from pruning or processing waste).

There are practical difficulties with some cases, such as greenhouse gas emissions and energy, and heat generated in processing, refrigeration and machinery operation.

A zero-waste approach can also include review and redesign of processes and equipment to minimise or eliminate the by-product (that is, part of a ‘cleaner production’ program), or to turn it into something useful, for example, systems to capture heat generated by refrigeration machinery.

Zero waste and extended producer responsibility are already influencing policies and programs in Australia. For example, the Western Australian Government waste strategy is called *Towards Zero Waste*, with the goal that all Western Australians live in a waste free society and a first principle of ‘prevention – to avoid the creation of waste’ (Department of Environment 2004).

The concepts involved in the zero-waste approach were taken up in the commonwealth/state/territory *Draft National Waste Policy Framework* issued in 2009. Extended producer responsibility was explicitly included as an element in the draft framework.

**Energy audits** – An energy audit is an example of a cleaner production technique and part of a pathway towards zero waste. The intention of an energy audit is to identify energy inefficiency so that remedial action can be taken.

**Environmental stewardship** – Many jurisdictions have environmental stewardship programs involving funding and other support for carrying out environmental works. For example, a current Commonwealth Government scheme is described as follows:

*Environmental Stewardship uses competitive auctions through which eligible private land managers can bid to provide a range of agreed management activities to protect, rehabilitate and improve particular ecological communities. Eligible land managers include farmers, Indigenous communities, and other managers of private freehold and leasehold land.*

*Successful land managers are contracted to manage nationally endangered ecological communities on their land and can receive funding for activities that are additional to their normal legislative responsibilities, for up to 15 years.*

*Relevant management activities could include:*

- reducing stocking and grazing intensity
- reducing fertilizer use
- expanding weed management
- undertaking or expanding replanting of native species (relevant to the ecological community) (Australian Government 2011)
Catchment management authorities also usually have similar schemes. For example, in Tasmania:

Each NRM region can provide land owners and land managers assistance to address their NRM needs and concerns by:

- sourcing technical advice
- information sharing
- accessing resources
- building links with other land owners, groups, industries and government
- developing project ideas
- attracting funds.

There are also many funding opportunities that may address your concerns and goals.

### 6.6 Monitoring and reporting

Monitoring is an important part of an environmental management system. It enables the measurement of progress and provides the basis for review of the initial enterprise environment policy and action plans.

It is common for monitoring to be based on checklists tracking accomplishment of specified tasks, photopoint records (for example, for landscape changes), or biophysical measurement data (for example, water quality parameters). What is done will invariably depend on the interest, skills and knowledge and resources of the enterprise management.

Monitoring activities may be direct (for example, counting bird populations) or indirect (for example, counting the bird predators).

Monitoring may cover pressures (for example, land clearing), state or condition (the bird counting example) or response (for example, revegetation of degraded areas or installation of updated and more efficient equipment).

Ideally, measurements used for monitoring should be able to be used more widely than at the enterprise level. Making them consistent with local requirements, for example, those of catchment management authorities, increases the prospects of taking advantage of regional support opportunities and can be part of a ‘good neighbour’ approach. The following example from the North East Catchment Authority in Victoria (2000–2011) illustrates the link between local and regional:

The North East Regional Catchment Strategy Monitoring, Evaluation, Reporting and Improvement Framework (MERIF) is an integral component of the RCS planning implementation and renewal processes. The tools, process and information developed and generated through implementation of the MERIF will inform both the development (renewal and review) and implementation of the Regional Catchment Strategy.

Specifically implementation of the Monitoring, Evaluation, Reporting and Improvement Framework will help the North East Catchment Management Authority in carrying out its functions to:

- monitor the state of the natural environment in the North East region;
- coordinate data collection from all projects under the North East Regional Catchment Strategy (RCS);
- demonstrate the contribution towards improvement in resource condition made by the projects prioritised under the RCS;
- provide performance information to inform the annual planning cycle for the Regional Catchment Investment Process (RCIP) and to improve and refine the RCS (adaptive management);
- be accountable to investors and community stakeholders; and
- effectively manage reporting processes.
A hard to realise goal of policy makers has been to use monitoring to serve many purposes, for example, see the Commonwealth Government’s selection criteria for national environmental indicators at Appendix 10. There has also been continuing work on integrating local action and broader reporting needs.

Increasing attention has also been paid to environmental reporting at an industry level, leading to the suggested approach for the ‘food value chain’ at Appendix 11.

The Global Reporting Initiative (GRI) is a network-based organisation that has developed a sustainability reporting framework. Several Australians are involved in the management of GRI. The initiative’s work includes food processing and its agriculture component.

The monitoring system used by an enterprise will need to accommodate its business and environmental priorities and the skills and knowledge available to it. Ideally, it will also fit in with regional requirements and national industry reporting.

### 6.7 Planning

Once all the impacts of an activity are identified the task ahead can seem overwhelming. Dealing with this problem is assisted by use of ISO 14001-based environmental management systems as they require some form of ranking in significance of the impacts and preparation of an environment policy that is a statement of the enterprise’s intentions about continuous improvement of its environmental management. This means that the planning can be customised to the circumstances and preferences of the enterprise. Naturally, the process should take account of any ‘neighbourhood’ issues, such as local landcare or catchment management priorities and activities.

Business planning is most likely to succeed if it takes into account all the social, personal, financial and production aspirations of all those involved. The outcome can then be a blend of environmental and other factors supporting each other as well as relating to ‘neighbourhood’ issues.

There will often be limitations on action because of resource and knowledge gaps. These can be accommodated with a plan involving:

- what can be done now with current knowledge, mechanisms and resources
- processes to identify knowledge and other gaps impeding further progress
- a strategy to overcome the gaps, and
- processes to ensure a quick start to implementation of readily agreed items.

To summarise:

- immediate use of an existing, internationally credible environmental management system is possible
- use of an existing system avoids confusion, delays and costs and provides a simple message for consumers
- there are tools available to assist the industry as a whole as well as individual enterprises
- supporting action programs exist
- practical monitoring and reporting arrangements with beneficial outside links can be developed, and
- manageable planning processes are available.
7. Making it happen

7.1 The issues

Environmental issues have high recognition by Australians. This is not, however, an indicator of what they do.

In a recent Sensis® Business Index Report (Sensis 2009) on confidence and behaviour of Australia’s small and medium enterprises (which nearly all olive businesses are) respondents ranked the significance of environmental sustainability 6½ out of 10, the same as economic sustainability, but only 41 per cent had made some change to their business as a result of environmental concerns (mostly in relation to waste and energy).

A South Australian assessment has pointed out that there are significant barriers to effective adaptation, including the need to overcome the gap between understanding the need and applying existing knowledge to deal with it (Bardsley and Sweeney 2008).

Although the value of environmental management systems is seldom questioned, their take up is low in agriculture compared with other industries (about 1 per cent of ISO 14001 certificates worldwide) and with product or production standard schemes, such as GlobalGAP.

Even in industries under pressure, the take up of environmental measures can be unexpectedly slow. The sugar cane growing industry, in response to concerns about the Great Barrier Reef and to the requirements of Queensland’s Environmental Protection Act 1994, introduced a Code of Practice for Sustainable Cane Growing in Queensland in 1998. All growers were sent a copy. A 2000 survey suggested more than a third had not read it, and only 79 per cent were aware of it (O’Grady and Christiansen 2000).

This issue has been identified in reports on the Commonwealth-supported EMS Pilots and Pathways programs, given preliminary analysis in the 2004 RIRDC report on environmental issues and the olive industry, and analysed in more detail in RIRDC Report 06/005, Environmental Management Systems Implementation in Agriculture (Mech 2006). These reports have had regard to reports of overseas experience as well as Australian experience.

The opportunities offered by positive action rather than just reaction and minimum legal compliance are illustrated by the following conclusion for a recent Academy of the Social Sciences in Australia roundtable:

*Today, an increasing number of corporations are seeking to combine the objectives of environmental protection and economic growth, whether by preventing pollution and thereby cutting costs and avoiding waste directly, by more effective risk management (including minimising the risk of accidents, costly cleanups, and environmental liability) or by gaining an increasing share of expanding ‘green markets’. Thus a common refrain is that going beyond compliance is both good for business and good for the environment.* (Gunningham and Holley 2010)

If certified systems with international credibility are adopted throughout the olive industry, it will have a competitive advantage over other countries and against competing fine food products in Australia. It will avoid the problems in other industries with their fragmented and insular approaches. Olive enterprises will be able to apply such systems to all the activities in their businesses.

Successful implementation of environmental management systems can be based on:

- market place benefits
- understanding and acting on the links between production and natural systems
- reducing costs
• tailoring support systems to accommodate the diversity of scale and type of operation in the industry
• relating to other rural management issues
• generating a quality management culture in Australia
• improving capacity for legal and regulatory compliance
• ‘good neighbour’ practices.

Not all of these issues will apply to all parts of the industry, for example, the direct reliance on natural systems is less for processing on a day-to-day basis. Shifts in location of the industry or contraction and seasonal fluctuation of fruit supply would, however, also affect processors and marketers.

The issue for the industry is what action it should take about these matters so that action on them generates incentives for take up, and overcomes the inaction and take-up problems mentioned above.

7.2 Market place benefits

The industry’s voluntary Code of Practice requires its signatories to implement and maintain an environmental management system. The code is one of the mainstays of promotion of Australian extra virgin olive oil, and will be extended to cover table olives. The code is intended to convey to the public that the Australian products are authentic, fresh, and of proven quality.

The code applies only to producers and traders of extra virgin oil (and later, table olives), that is, it applies directly only to a proportion of industry members. A distinguishing feature of the industry at all scales from micro to very large is vertical integration, so, in practice, introducing a system to cover processing will automatically pick up fruit production, distribution and sales.

It is also recognised that code compliance could be jeopardised by the actions of suppliers of fruit and other inputs, and of contractors. Therefore, the latter are inexorably being drawn into the code framework.

If a universal, multi-enterprise environmental management system such as ALMCS is used, the system can then more generally be used as part of the marketing platform for other products. Similarly, such a system also provides the platform for complying with product or production standards, for example, GlobalGAP and codes used by some grocery chains.

Use of environmental management schemes will also be more attractive if they can be linked with incentive schemes, such as some offered by catchment management authorities, or with regulatory relief. The latter can range from freedom from detailed permit conditions to milder forms of checking and surveillance. The industry organisations can join in lobbying appropriate authorities to achieve these outcomes.

7.3 Environmental information

This issue has two important elements:

• understanding the relationship between production and natural systems
• access to information relevant to particular enterprises to help determine how best to achieve improved environmental outcomes.

There is no doubt considerable awareness in the industry of the first issue at the highest levels of generality, for example, the general climate parameters applying to olive growing, the recognition of the value of irrigation for optimum yields, and the impact of some obvious relationships, such as planting olives close to olive lace bug habitat, the impact of strong winds on flowering and pollination, and the impact of severe frost and hail on fruit.
It is reasonable to assume that the greater the knowledge about the environment and its relationship with production, the greater the likelihood that enterprises will manage environmental issues systematically and productively.

There is already considerable information available on many specific natural resource issues, for example, in the *Guidelines for Environmental Assurance in Australian Horticulture*, from Horticulture Australia Ltd, and other industry publications such as *Sustainable Grazing* from Meat and Livestock Australia. Effective take-up systems would be facilitated by the production of short guides to olive industry–environment links in different regions to point the way to greater harmony between the industry and the environment and to reduced impact on the environment.

There is also the usual challenge of achieving the necessary behavioural change so that the available information is acted upon. The industry at all levels will need to explore the best ways to achieve the greatest behavioural change in the shortest possible time, for example, by using social marketing techniques (McKenzie-Mohr 2011) and generating approaches that are most effective for different situations, using examples such as those contained in *Rural Lifestyle and Landscape Change: Emerging Challenges for Extension* (Hollier and Read 2007).

### 7.4 Reducing costs

Any management program aimed at reducing environmental impacts should lead to cost reductions from more efficient use of energy and machinery, better maintenance of machinery and other equipment, reconsideration of designs and practices where energy is a major cost, improved logistics, more likely production of valuable by-products and more careful matching of investment in machinery and other equipment to provable needs. For example, energy studies carried out in the global warming context have consistently shown that energy efficiency strategies are the cheapest form of greenhouse gas abatement, involving reduced costs, quite significant in some cases such as commercial buildings (Gurney et al. 2007; McKinsey & Company 2008; ClimateWorks Australia 2010). There is also the opportunity to avoid or reduce cost increases. For example, US defence analysts suggest energy costs will be greater (and energy security less) as soon as 2015 (US Joint Forces Command 2010).

The National Waste Policy points out that:

> By deploying existing and innovative technologies for better waste avoidance, reprocessing and recycling across different locations, scales, waste streams and materials, business, industry and consumers can save money, water and energy and avoid greenhouse gas emissions and pollution. (Department of the Environment, Water, Heritage and the Arts 2009)

Previous research suggests that the direct costs and associated record keeping for an environmental management system have not been a major issue. The record keeping can contribute to rationalisation and improvement in enterprise information management and planning (Carruthers 2005).

There can be higher costs if full certification to ISO 14001 is pursued. A system with several categories such as ALMCS avoids this, and enables costs to be contained. At the moment (2010) the costs for ALMCS start-up are covered by FarmReady grants. Subsequent costs are for auditing (see Appendix 6) and for any environmental initiatives undertaken beyond those such as energy use changes that reduce enterprise costs.

### 7.5 Recognising scale

Olive production enterprises range from very small to very large, with most of the smaller end being micro-businesses.

Experience in other industries is that larger organisations often have staff, systems and other resources that make adoption and maintenance of new processes relatively painless. Generally, micro-businesses are not so well placed. Positive action from enterprise to industry-wide levels can simplify the process. For example:
**Enterprise level** – personal study, use of outside expertise, participation in industry organisation activities

**Regional level** – preparation and dissemination of locally relevant environmental information and of contact lists of potential assistance, encouraging extension and group activities involving local agencies and educational and training institutions, organising local activities

**State level** – assistance to the regions, similar activities to those at regional level, preparation and dissemination of state level material, including on legislative compliance

**National level** – preparation and dissemination of national-level information, including on legislative compliance, chemical approvals and information, use of national Expo, participation in national programs such as the National Packaging Covenant, recognition systems, strong institutional arrangements, research and development.

### 7.6 Local social and economic drivers

As already stated in this report, for example, in Chapters 3 and 4, the circumstances in which olive enterprises operate vary considerably from place to place. This variation applies just as much to social and economic factors as to biophysical factors. A workshop organised by the Australian Academy of Science in 2009, *Agricultural Productivity and Climate Change*, concluded:

> ... that from a productivity perspective, climate change should be seen not as a single monolith to hit Australian farmers, but as one component in a complex set of processes in which all stakeholders – farmers, scientists, exporters, communities and policy-makers – are already entwined: that maintaining and improving agricultural productivity will bring with it significant and complex biophysical, environmental, social and economic challenges across the agricultural sector. (Lambeck 2010)

In some areas there will be strong landcare, production or service groups that can provide a foundation and source of information for new systems. There may be other local means of useful networking.

There may be cases of relatively absentee ownership of operations, for example, many olive operations in southern New South Wales are owned by people living in Sydney. Regional and state organisations could establish networks that help overcome this isolation and distance factor.

Factors beyond the olive industry may affect the viability of the industry in particular localities, for example, population and hence local market decline or changed access to water. Use of environmental management systems can help cushion enterprises and provide the space needed for new or different enterprise approaches.

### 7.7 Indicators and reporting

The significance of indicators and reporting were canvassed in Chapter 6, Section 6.6. Careful choice of environmental priorities with appropriate indicators can ease the way for introduction of an effective system.

The priorities can align with operational activities, for example, chemicals management or machinery use. They may be driven by legislation and regulatory systems, for example, waste management. Indicators should have the following attributes:

- reflect environmental legislation – this is a responsibility of everyone and a Code of Practice requirement
- reflect the enterprise’s primary environmental objectives
- cover all significant environmental impacts
- reflect the concerns of interested parties – these could be neighbours, consumers, workers
• meet the needs of users of the indicator information – for example, workers, contractors, investors, regional groups, regulators, the rest of the industry.

7.8 Recognition and rewards

Many in the industry will, and no doubt already do, pursue better environmental management for personal satisfaction, cost containment, good citizenry and other reasons without any overt outside recognition.

They can be recognised and newcomers encouraged by such means as signage and website listing. The Australian Olive Association at national, state and regional levels could introduce systems of annual awards and provide guidance on how participation can be used as a marketing tool.

There are obvious advantages in using an environmental management system and with certification processes that cover all activities in an enterprise in an internationally credible way.

The sustainability and environmental tests used by major food buyers do not discriminate in terms of products, as indicated in Chapter 5, Section 5.1. Systems such as ALMCS accommodate the needs of the enterprises and the buyers in a single system.

7.9 Institutional issues and integration

There is no single, simple solution to the problem of rapid and effective implementation of new systems, environmental or otherwise. The industry needs to introduce and maintain mechanisms for adoption. These need to be sensitive to many factors, including costs and benefits, differences of scale of enterprise, pressures in different areas and any likely or known barriers to adoption. Therefore, institutional and integrative arrangements are needed to provide an encouraging framework for individual enterprises as well as helping to ensure continuing positive industry-wide effort.

**Permanent machinery** – The Australian Olive Association already establishes committees and working groups involving directors, industry volunteers and experts. It could establish an Environmental Management Committee with a technical support group or network drawn from research, industry, government and community interest groups.

Investment in an environmental officer would facilitate quicker and more effective take up of better environmental practices and quicker realisation of the benefits from this. Typically, an environmental officer would be involved in a range of facilitation activities, such as capacity building, development of productive partnerships and extension services, communication, research, monitoring and reporting, and servicing relevant industry bodies. This approach has been well proven in other industry organisations and in community organisations such as landcare groups.

Industry trade fairs, field days and similar events can have an environmental component.

**Integrated approach** – Progress will be most rapid with an integrated approach covering activities such as education and training, investment, monitoring and reporting, and research and development, with close links to other national industry activities such as the Code of Practice, chemicals management and consumer awareness, including on ‘good neighbour’ issues. An integrated approach should enable earlier and more productive understanding of the linkages among good environmental management, production, quality products, occupational health and safety, public image, marketing and profits.

**Charter or policy** – Some industry members already have environmental charters or policies, as do some suppliers to the industry and others in the supply chain. Some belong to other industry organisations that have them.

The International Chamber of Commerce (ICC) *Business Charter for Sustainable Development* is reproduced at Appendix 12. ICC Australia has been in operation since 1927, so it can be expected that this charter is taken into account by many major businesses in Australia.
The Keidanren (Japan Business Federation) *Global Environment Charter* is at Appendix 13. Environment charters and policies are common in Japan, where they are associated with the broader concept of quality management and product.

Many major businesses around the world belong to The Coalition for Environmentally Responsible Economies. Its principles require attention to:

1. protection of the biosphere
2. sustainable use of natural resources
3. reduction and disposal of waste
4. energy conservation
5. risk reduction
6. safe products and services
7. environmental restoration
8. informing the public
9. management commitment
10. audits and reports.

If the industry has an environmental charter it will be demonstrating to the community at large that it takes environmental responsibility seriously and that it understands the important place of environmental management in pursuit of quality and public acceptance of the industry and its products.

The international charters and an industry charter, in turn, provide guidance and inspiration for individual enterprises.

A possible charter to support improved environmental management through the industry is proposed in Chapter 8.

To summarise:

- the industry should use only internationally credible environmental management systems with certification processes
- links with market place benefits, information availability, cost reductions, scale of operation, local social and economic factors, indicator and reporting systems, and recognition and reward systems can facilitate rapid and effective implementation of environmental management systems
- effective dissemination of information and achievement of rapid behavioural change are needed
- the introduction of systems and their continuing effectiveness will be enhanced by permanent industry institutional arrangements (including an environmental officer), an integrated approach and adoption of an environmental charter.
8. Environmental charter

8.1 The tests for a charter

As indicated in Chapter 7, Section 7.9, there are advantages in the industry having an environmental charter.

These advantages include keeping up with what some Australian Olive Association members already do, with international charters influencing developments in Australia and overseas, and with general legislative requirements already binding on industry members, such as the ‘general environmental duty’ in Queensland legislation and land management legislation in other jurisdictions.

The industry needs to be resilient and adaptable because of the changing environment affecting the industry – natural, market, competition, regulatory. A progressive environmental charter as an important pillar of quality, production efficiency and good neighbour outcomes can make a substantial contribution to achieving that resilience and adaptability.

Similarly, it can continue to be one of the cornerstones of research and development activity, as environmental factors are central to other typical research and development topics such as production efficiency and product qualities. Australia’s biggest plant industry (grains) has already recognised this – it has stated that it ... will establish environmental strategies as a cornerstone of grains R&D (Blumental et al. 2008). This proposition underpins the submission from the New Rural Industries Australia alliance to the Productivity Commission’s inquiry on Rural Research and Development Corporations (Miller 2010). The alliance represents about twenty industries.

In a December 2009 report to members by the Australian Olive Association, the majority of past beneficial research activities cited to support a bid for fund raising from members were environmentally based (chemistry of olive oil, integrated pest management, climate-oil quality relationships, harvesting timing, irrigation and waste management). The three projects selected for immediate action are all environment-based or related (storage of oil, pest control and chemicals management).

A charter can also help ensure that the industry avoids the two dead-end alleys of reductionism and simply reacting to an issue after it becomes important.

As indicated in Chapter 4, Section 4.1, a reductionist approach means concentrating on the ‘issue of the day’, for example, salinity a few years ago, carbon issues today, at the expense of the complex whole that affects all parts of the industry. A charter can be a driving force for a holistic, forward looking and innovative culture in the industry.

In some industries systems based on ‘best management practices’ are used. The risks with that approach are that they can contribute to a reactive, historic and ‘continuous business as usual’ mindset rather than one of ‘continuous improvement’. It has also been pointed out that a risk with ‘best management practices’, particularly where their take up depends on the use of consultants and ‘knowledge brokers’, is that they ... provide generic advice that can ignore individual circumstances (Marsh 2010). This is not to deny the value of attempts to identify and set out best known practices and material made available as a result. As indicated in Chapter 4, Section 4.3, the consequences of the global changes now underway are not predictable by recourse to history. It is better to assume that the future holds surprises, and may even be unknowable. Therefore, it is better to adopt open-ended systems more likely to assist with adaptability and resilience as circumstances change within and beyond the industry. The current explosion of work on soil quality issues has highlighted the problem of assuming there is a ‘best practice’.

The charter should therefore reinforce the view that the industry should be alert, active and adaptive, rather than tied to history and limited to passive reaction to the changing natural and policy world in which it operates.
Similarly, the charter needs to support the use of management systems that can accommodate uncertainty and changes while retaining a focus on straightforward goals of quality, efficiency and reputation.

The Queensland *Environmental Protection Act 1994*, which is binding on the olive industry along with all others, includes conservation of biological diversity as a basic component of its ‘general environmental duty’. Biodiversity is the major linking factor in all natural systems, as it is an expression of the interaction of all the forces of nature, including human activities, at work in a particular time and place. It changes with changes in any components of the natural systems. So a charter with biodiversity as a common thread and touchstone ensures that all issues are covered, and that new ones can be accommodated easily.

A charter can also publicise and entrench industry institutional arrangements and progressive and continuous management systems supportive of good environmental practices, and therefore support economic, financial, production and social goals as well.

With these considerations in mind, a possible charter to support improved environmental management through the industry is set out in Table 4.

**Table 4: Proposed olive industry environment charter**

<table>
<thead>
<tr>
<th>Australian Olive Industry Environment Charter</th>
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<tbody>
<tr>
<td><strong>The need</strong></td>
</tr>
<tr>
<td>Olive growing is dependent on natural systems. Olives are grown extensively in Australia - along the temperate coasts, in the temperate highlands and on the temperate slopes and plains - with the boundaries of the industry determined by natural environmental factors. Olive products are sold and consumed all over Australia.</td>
</tr>
<tr>
<td>The industry from plant nursery through to olive growing, processing, distribution and sales to consumption has environmental impacts, from very local, to contributions to global changes.</td>
</tr>
<tr>
<td>The community expects environmentally sensitive production. Much of the industry’s product is exported, so expectations of overseas buyers are equally important.</td>
</tr>
<tr>
<td>Many laws in Australia at national, state and local level and overseas laws for exporters, applying to the industry, relate to containment or elimination of adverse environmental impacts.</td>
</tr>
<tr>
<td>The industry’s voluntary Code of Practice for authenticity and quality of extra virgin olive oil requires the use of environmental management systems based on continuous improvement principles with particular attention to biodiversity. Biosecurity depends on good environmental management.</td>
</tr>
<tr>
<td>Many olive growers are also involved in other rural industries, such as livestock, grain, wine grapes and other horticulture. Everyone in the industry operates in the wider community. Environment issues also overlap with management, cost and quality issues. They affect the adaptability and resilience of the industry. These will all suffer if the environment component is neglected.</td>
</tr>
<tr>
<td>Good environmental management is therefore needed for product quality, production efficiency, biosecurity, market acceptability, good neighbourliness and industry resilience and adaptability.</td>
</tr>
<tr>
<td><strong>The industry commitment</strong></td>
</tr>
<tr>
<td>The industry will:</td>
</tr>
<tr>
<td>• reduce its impact on the environment</td>
</tr>
<tr>
<td>• accept its share of responsibility for environmental impacts for the whole life-cycle of products</td>
</tr>
</tbody>
</table>
continually improve its environmental performance
assist its members, staff, contractors and others in the product chain to meet these commitments routinely and efficiently
be a good neighbour.

Reducing the impact
The industry will identify all the potentially adverse environmental impacts of each facet of the industry – nurseries, olive groves, processing, distribution and sales and consumption. These impacts will relate to water use, fertiliser and chemical use, site management, soil condition, hydrology, building and machinery, energy use, packaging, storage, transport, waste management and any associated activities such as cropping and livestock management.

The industry will facilitate action to reduce adverse impacts, including measures such as reduction of inputs, efficient use of resources, reduction in fossil fuel energy use, and reduction or elimination of activities threatening biodiversity. The industry will seek to harmonise industry activities with natural systems.

The industry’s aim is to develop and implement zero-waste programs, involving as necessary the redesign of processes so that ‘waste’ does not leave a site except for sale or as an input to another process, or where the law requires it, for example, a regulated hazardous substance.

Life cycle responsibility
Life cycle assessment will be used to identify environmental impacts throughout the product chain and will identify the other parties involved in the chain to enable development and implementation of co-operative activities with them designed to reduce environmental impacts from the inputs, products and by-products of the industry.

Continuous improvement
The industry will adopt management systems involving continuous improvement principles and flexibility to suit individual enterprises. These systems will have international credibility and integrity, support product and performance standards affecting the industry, accommodate regional environmental needs, and facilitate well-informed, quick and effective responses to changing circumstances.

Meeting the commitments
The industry will work with others to meet its commitments, developing partnerships with other industry groups, government agencies and voluntary organisations.

Continuing investment in research and development, information systems and extension activities will support industry members in their efforts.

The industry will:
• adopt, develop and promulgate tools to assist with achieving environmental improvement goals
• make the environment a cornerstone of industry research and development activities
• ensure that staff, contractors and others in the product supply chain acquire the skills, knowledge and resources needed to facilitate achievement of the industry’s environment goals
• foster the take up of existing programs relevant to the industry
• establish permanent machinery to ensure long-term commitment, continuity and capacity to review and adjust industry environmental commitments.

Being a good neighbour
The industry wishes its activities to harmonise with those of others. To foster this it will:
• increase and update its knowledge of consumer expectations on environmental issues
• publicise the industry’s environmental goals, programs and achievements
• harmonise enterprise and regional environmental goals with those of the region
• develop environmental strategies and programs with regard to local social, cultural and economic aspirations.
Understanding the outcomes

The industry will develop and use monitoring techniques and environmental reporting on farm and on an industry-wide basis to fit in with others and to contribute to development of regional and national environmental programs.

The industry’s environment charter will be a success if it leads to:

- no net loss of biodiversity, soil and soil condition and health,
- a net positive contribution to atmospheric stability
- restoration of degraded environments, or, at least, timely and substantial reversal of degradation,
- maintenance of inter-generational equity, so that future generations have access to at least the same or equivalent level of resources and amenity as we enjoy now
- the industry being welcomed in local communities.

To summarise, an industry environmental charter should:

- support quality and production efficiency
- be the cornerstone of industry research and development
- embrace a holistic approach
- support systems for anticipating and acting on new issues
- publicise and entrench industry institutional arrangements supporting continuing better environmental management.
9. Other national action

9.1 Introduction

There are several initiatives and opportunities for action the olive industry can pursue at a national level to assist with achieving better environmental outcomes in addition to adopting a progressive environment charter. There are proposals for national recognition and reward systems and permanent institutional arrangements to support better environmental outcomes and the integration of environmental issues into quality and profitable production management in Chapter 7.

9.2 Research and development

Research and development is important for increasing knowledge, narrowing uncertainties, sharpening predictions and increasing confidence and success in decision making.

The industry will benefit from keeping up to date with research by others on issues affecting it. For example, there is renewed activity by governments and research organisations on soil management under the auspices of the National Committee on Soil and Terrain (see Campbell 2008; National Committee on Soil and Terrain 2009; ACLEP undated).

There are also several areas of interest for research and development investment by the industry. As background to this, it is suggested that the two major focuses for research and development to support successful long-term development of the olive industry are:

- achieving and maintaining quality
- achieving production efficiency.

As suggested in Chapter 8, Section 8.1, the environment is the logical cornerstone of these. As argued in this report, good environmental management contributes to a quality industry and quality olive products. As good environmental management reduces costs and provides a basis for value-adding and marketing, the link with production efficiency is obvious.

The need for research on several issues for effective responses to climate change factors, based on preliminary studies in South Australia in particular, has been emphasised before (Department of Water, Land and Biodiversity Conservation 2008).

Topics for action as soon as possible include the following:

**Life cycle assessment** – Using the European project (Technical University of Crete 2007) as a starting point, a life cycle assessment for selected regions would provide a solid foundation for many industry activities and ensure that the industry is not left behind, for example, as the work of the Sustainability Consortium takes hold.

**Relationship with the environment** – There are several possibilities, for example:

- the impact of olive growing on local ecosystems, including biodiversity surveys
- harmonising olive growing with natural systems
- maximising the habitat value of olive industry enterprises
- continuing work on integrated pest management
- water use
- olives as weeds.

The ‘olives as weeds’ problem could become worse if reduced water availability (or lower returns, higher costs or loss of interest) leads to abandonment or neglect of groves.
**Supporting environmental management systems** – There are several activities that if done at a national level will assist individual enterprises as well as the industry as a whole. They include research on:

- linking olive industry operations with regional natural resource management goals, priorities and programs
- developing indicators and monitoring and reporting arrangements (see Chapter 6, Section 6.6)
- the range of policy instruments, including negative and positive incentives, interventions by non-industry and supply chain parties and regulation desirable to support environmental management systems.

**Resilience and adaptation** – This topic is briefly covered in Chapter 5, Section 5.2. Research is needed to:

- identify and understand the possible regional biophysical, social and economic changes from global changes affecting the boundaries for olive growing, olive production and social and economic circumstances affecting industry viability
- grow olives with less water
- understand resilience in the olive industry context and the factors supporting it
- identify supply chain and marketing options for variable production.

**Waste** – Continuing research is needed on processing-waste management, the scope for extended producer responsibility/product stewardship in the industry and on cleaner production techniques, including energy efficiency, from ‘cradle to grave’.

**Consumer recognition** – Walmart points out that:

> The final step of the (Sustainability) Index is to provide customers with product information in a simple, convenient, easy to understand rating, so they can make choices and consume in a more sustainable way. How that information is delivered to consumers is still undetermined, but could take the form of a numeric score, color code or some other type of label. The sustainability consortium will help determine the scoring process in the coming months and years. (Walmart Corporate 2009b)

The issue for the industry is to identify and act on the triggers for Australian consumers (and overseas ones in some cases) to respond to better environmental management. Certification systems, regulations, standards, various styles of promotion and advertising and symbols may all have a role in this.

**Public good issues** – A ‘public good’ issue arises wherever people have free access to a product or service that cannot be produced without providing the benefit. For example, enhancing natural systems to support higher agricultural productivity provides benefits for all of those whose well-being depends on those natural systems.

As various incentive schemes may be tied to ‘public good’ ideas, however loosely or incoherently, it would be to the industry’s advantage to understand and be able to articulate strongly all ‘public good’ outcomes of its operations.

Market failure occurs where market transactions have consequences that are not limited to those who are involved in the transactions. Public good issues are one example. The *Stern Review on the Economics of Climate Change* (Stern et al. 2006) states that climate change is the greatest and widest-ranging market failure ever seen. The industry would benefit from a better understanding of market failure issues adversely affecting it, and of how these might be addressed to its advantage.
Assistance in refining research agendas can be obtained from work already undertaken by others, such as for horticulture generally, for example, the *Horticulture Climate Change Action Plan* (HAL 2009).

The industry will know the research and development program and its administration are successful if there is evidence that the level of knowledge about industry issues has increased, uncertainties facing the industry are reduced or the options available to deal with them have increased, and the outcomes of research are being taken up within the industry. Over the longer term, the test would be the relationship between the program’s outcomes and the overall profitability and persistence of the industry.

### 9.3 Compulsory levy system

The December 2009 request from the Australian Olive Association for donations from members to support research and development and the very small program underway establish the need for a higher, continuous and certain funding stream.

A national compulsory levy system increases funds available for research and development, achieves some ‘public good’ recognition through commonwealth funds, increases certainty and continuity in research funding and processes, helps institutionalise effective partnerships with other parties, generates favourable publicity, and overcomes the current advantage of other industries with levies. Achieving this should be one of the highest priorities of the industry.

### 9.4 Organic production

In 2003 the Australian Olive Association released a publication, *Organic Olive Management – a guide for Australian olive growers* (O’Malley et al. 2003). There would be value in reviewing the publication to ensure that it incorporates any relevant information and practices brought to light since then. The publication could then be a useful resource for all growers, as organic and bio-dynamic practices include many of relevance for environmental management, such as the use of renewable resources, conservation of energy, soil and water, recognition of livestock welfare needs, and environmental maintenance and enhancement, while producing optimum qualities of produce without the use of artificial fertiliser or synthetic chemicals.

### 9.5 Government programs

There are always government programs at national, state and territory, and local levels that can support environmental action, for example, the National Packaging Covenant. These vary from place to place and time to time, so it is in the interests of the Australian Olive Association to maintain an up-to-date register of opportunities, and for the state and regional arms of the association to do likewise in their areas.

The Commonwealth Department of Infrastructure, Transport, Regional Development and Local Government maintains a website, ‘Regional Entry Point’ (<http://www.regionalaustralia.gov.au>), that lists many useful commonwealth, state and territory programs that might assist business in rural Australia.

The industry has a good record of positive results from interaction with governments. This needs to continue so that its needs and any unique characteristics are taken into account in government decision making.
To summarise:

- research and development is important for increasing knowledge, reducing uncertainty, sharpening predictions and increasing confidence and likelihood of success in decision making.

- the industry will benefit from keeping up to date with research by others on issues affecting it.

- the industry research and development activities should include life cycle assessment, industry-environment relationships, support for environmental management systems, resilience and adaptation, waste, consumer recognition, public good issues and market failure issues.

- the research and development program will be successful if it increases knowledge in the industry, helps overcome uncertainties, and if its outcomes are taken up in the industry.

- a national compulsory levy system is needed to support research and development.

- many organic and bio-dynamic practices are relevant for environmental management generally.

- the industry should, wherever possible, take advantage of government programs, and seek to ensure government decision making has regard to its needs.
10. Action guides

10.1 The issue

As pointed out in Chapters 3 and 4, the spread of the industry and the many differences within it means that it is not feasible to be prescriptive about required practices and approaches for all enterprises in Australia.

This mirrors conclusions reached in Europe and for horticulture generally in Australia. For example, the *Guidelines for Environmental Assurance in Australian Horticulture* (Lovell 2006) are based on, among other things, the propositions that the guidelines cannot be all things to all people, and that different people want different levels of assistance (some growers who trialled a draft of the guidelines wanted more simplification, others wanted more detail), and that more site-specific information would be needed for enterprises.

There is also the risk that more detailed approaches as can occur with ‘best management practice’ guides can lag behind research advances and, if they are to accommodate differences in scale and circumstances, become very extensive and detailed. In sugar cane growing, where a code of practice was introduced in 1998, subsequent review has suggested that a sensible starting point is more general goals (Rolfe et al. 2008).

Similarly, in Europe, it has been concluded that the single best approach is implementation of an environmental management system (see Chapter 3, Section 3.2), rather than prescription of particular practices.

The most detailed review of options for dealing with processing and table olive waste (Niaounakis and Halvadakis 2006) emphasises that the possibilities depend on factors such as local circumstances, regulatory systems and community expectations. This conclusion is from European experience, but there is no reason to expect that the situation is any different in Australia. A RIRDC report on regional olive processing highlighted that formal requirements for processing operations vary from state to state, and within states (Meyers Strategy Group Pty Ltd 2001).

10.2 Ways ahead

There are, however, several positive steps that can be taken to put all in the industry on a positive track to financially effective, risk reducing and continuously improving environmental practices. The first, as recommended in this report and in Europe, is adoption of internationally credible environmental management systems, such as ALMCS with its national application or any local equivalent developed for a local application.

A second is to publicise and explain within the industry that there are industry-wide issues that require effort, even if priorities and the approach needed will vary from place to place and enterprise to enterprise, see for example the list of issues presented in Chapter 3, Section 3.3.

There is a need to link the use of environmental management systems with the proposed industry charter in Chapter 8 and with industry-specific action. A productive way to do this would be for enterprises to adopt their own environment charters, as illustrated below for olive processing plants (Table 5) and olive groves (Table 6).

This is not intended to reflect a ‘one size fits all’ approach, each enterprise would cover whatever its needs and circumstances require. Such charters demonstrate commitment, provide a check list of relevant items, generate staff awareness, provide day-to-day operational guidance, and provide a public demonstration of environmental awareness and responsibility.
Table 5: Enterprise environment charter – olive processing plant

**Olive processing plant**

Following is a check list for public display, staff awareness and operational guidance in an olive oil processing plant.

**(BUSINESS NAME) OLIVE PRESS ENVIRONMENT CHARTER**

We are committed to good environmental management, to reducing our impact on the environment and to continual improvement in everything we do. We support the Australian Olive Industry Environment Charter and major goals for energy efficiency, reduction in fossil fuel dependence, biodiversity protection and zero waste. In our operation, we:

**Information and raising awareness**

- Make sure our staff are aware of environment issues and understand the links between good environmental practices, quality product, cost containment and being a good neighbour
- Integrate good environmental practice into all jobs
- Tell our visitors and clients about our environmental record

**Energy**

- Carry out energy efficiency audits
- Monitor and analyse energy use
- Seek energy saving technical improvements, equipment, machinery and vehicles
- Carry out regular and preventive maintenance
- Use low energy lighting
- Implement techniques for recovering waste energy
- Use solar hot water heating
- Use other renewable energy sources wherever possible
- Maintain well-insulated buildings
- Use natural processes for heating and cooling wherever possible

**Water**

- Monitor and analyse water use
- Use water-efficient machinery
- Use water flow regulating systems
- Use (water-efficient) (waterless) toilets
- Harvest rainwater
- Use pervious surfaces in the grounds of buildings
- Use landscaping to retain water in the grounds of the building
- Recycle greywater

**Landscape and biodiversity**

- Landscape the grounds of our buildings to avoid erosion and soil loss
- Maintain perennial-based plantings and 100% ground cover all of the time
- Use plantings to complement energy use efficiency
- Avoid use of herbicides and fertilisers
- Control or eradicate pest plants and animals
- Use local and regional catchment management targets in determining landscape practices
- Participate in local landcare and other community environment activities

**Waste**

- Carry out waste audits
- Maintain quality controls to avoid product return
- Recycle paper, glass and metal waste
- Compost processing and landscaping waste
- Recycle ink cartridges
- Dispose of batteries and electrical equipment for recycling or re-use
- Treat waste-water
- Organise transport and product logistics as efficiently as possible
**Green purchasing and packaging**
- Use packaging with smaller environmental impacts
- Use recycled paper products
- Use cleaning products with least environmental impact
- Favour the use of ecolabel products

**Management**
- Are members of ALMCS (or local equivalent)
- Apply industry research and development and innovations as soon as practicable
- Provide data to our industry organisation to contribute to public reporting of industry environmental impacts and achievements
- Comply with legal requirements for our operation
- Participate in industry biosecurity programs
- Favour processing olives from groves subject to ALMCS (or local equivalent)
- Favour furniture and office equipment and supplies made with least environmental impact

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**Table 6: Enterprise environment charter – olive grove**

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**Olive grove**

Following is a check list for public display, staff and contractor awareness and operational guidance for an olive grove where no processing occurs at the grove site.

**(BUSINESS NAME) OLIVE GROVE ENVIRONMENT CHARTER**

We are committed to good environmental management, to reducing our impact on the environment and to continual improvement in everything we do. We support the Australian Olive Industry Environment Charter and major goals for energy efficiency, reduction in fossil fuel dependence, biodiversity protection and zero waste. In our operation, we:

**Information and raising awareness**
- Make sure our staff and contractors are aware of environment issues and understand the links between good environmental practices, quality product, cost containment and being a good neighbour
- Integrate good environmental practice into all jobs
- Tell our visitors and clients about our environmental record

**Energy**
- Carry out energy efficiency audits
- Monitor and analyse energy use
- Seek energy saving technical improvements, equipment, machinery and vehicles
- Carry out regular and preventive maintenance
- Use low energy lighting
- Implement techniques for recovering waste energy
- Use solar hot water heating
- Use other renewable energy sources wherever possible
- Maintain well-insulated buildings
- Use natural processes for heating and cooling wherever possible

**Water**
- Monitor and analyse water use
- Use water-efficient machinery
- Use soil moisture measuring equipment
- Use controlled irrigation systems
- Maintain water distribution systems to avoid losses
- Use mulch to minimise water use
- Use water flow regulating systems
- Use (water-efficient) (waterless) toilets
Harvest rainwater
Use pervious surfaces in the grounds of buildings and on roadways
Use landscaping to retain water in the property
Recycle grey water

**Landscape and biodiversity**
Landscape the grounds around buildings, use windbreaks and build and maintain tracks and roadways to avoid erosion and soil loss
Maintain perennial-based plantings and 100% ground cover all of the time
Maintain at least 30% of our land as natural habitat
Link our natural habitats with those of neighbours
Use plantings to complement energy use efficiency
Avoid or minimise use of herbicides and fertilisers
Control or eradicate pest plants and animals, including feral olives
Use local and regional catchment management targets in determining landscape practices
Participate in local landcare and other community environment activities

**Waste**
Carry out waste audits
Maintain quality controls to avoid product return
Recycle paper, glass and metal waste
Compost waste
Recycle ink cartridges
Dispose of batteries, electrical equipment and machinery for recycling or re-use
Treat waste-water
Organise transport and product logistics as efficiently as possible

**Green purchasing**
Use recycled paper products
Use cleaning products with least environmental impact
Favour the use of ecolabel products

**Management**
Are members of ALMCS (or local equivalent)
Apply industry research and development and innovations as soon as practicable
Provide data to our industry organisation to contribute to public reporting of industry environmental impacts and achievements
Practise farm hygiene
Comply with legal requirements for our operation
Participate in industry biosecurity programs
Favour furniture and office equipment and supplies made with least environmental impact
Such charters can also help inform industry organisation investment decisions, including for research and development.

Individual enterprises need to take advantage of industry training and information, including research and development reports, and extension and similar services available from government agencies, other industry organisations, research institutions, and rural services and other commercial providers.

As indicated in Chapter 5, there are several systems and tools available to help enterprises improve their environmental effort with simultaneous business benefits. Several of these are promoted by increasingly influential organisations such as the United Nations Global Compact (UN Global Compact Office 2011), and so will influence the national and international supply chains for the olive industry.

Surveys and company reports for the Global Compact suggest that many businesses make relatively little use of techniques such as life cycle assessment, eco-design and technology management (UN Global Compact Office 2008). Therefore, there is opportunity for seeking competitive advantage by recourse to these approaches where possible. Working with others in the supply chain may have similar advantages.

10.3 Site specific advice

As elaborated in this report and others about this and other industries, it is not possible to provide environmental recipes applicable to all. It would probably also be counter-productive to attempt to provide a useful list of sources of detailed information. For example, the Information Sources document prepared by the Cooperative Research Centre for Viticulture and the Victorian Department of Primary Industry (Cooperative Research Centre for Viticulture 2005) is twenty-seven pages long.

The suggested approach is to start with more general guides to environmental issues and sources of information.

In all cases, the following is helpful for understanding and dealing with risk management:

*Principle 7: Recognise and Manage Risk*, Deloitte, Blakiston & Crabb and ASX Markets Supervision 2009

Documents that enterprises can use as a basis for action include:

*Nursery & Garden Industry Australia Ltd Environmental Sustainability Position*, Nursery and Garden Industry Australia Ltd, 2009


*A Biodiversity Strategy and Plan for the Australian Rice Industry*, D Freudenberger and J Stol, CSIRO 2002 – this plan is easily adaptable for application in other situations

*Soil carbon for carbon sequestration and trading: a review of issues for agriculture and forestry*, J Walcott, S Bruce and J Sims, Bureau of Rural Sciences 2009

*Carbon Grazing – The Missing Link*, A Lauder, Saltbush Systems Pty Ltd 2001


*Recycling Solid Waste from the Olive Oil Extraction Process*, N Nair and J Markham, RIRDC Publication No. 08/165
As many olive enterprises are combined with other rural enterprises, the following are also useful:

*Towards Sustainable Grazing*, W Mason, L Warn & G Cahill (eds), Meat & Livestock Australia Ltd 2003

*Adapting Agriculture to Climate Change*, C J Stokes & SM Howden (eds), CSIRO 2010

*A Responsible Lead: an Environmental Plan for the Australian Grains Industry*,
M Blumenthal, A Umbers & P Day, Grains Research and Development Corporation 2008

The world-wide-web based tool, myEMS <www.myems.com.au/> , used with ALMCS has default material that helps identify environmental impacts and ways to deal with them.

Dealing with most environmental impacts involves consistency with regional environmental activities. All olive enterprises in Australia are in one of the natural resource management regions supported by catchment authorities established by state and territory governments. The natural resource management region relevant to any particular enterprise can be found easily on <www.nrm.gov.au/nrm/region.html>. Entries for each region include a regional summary, priority issues, a reference to the regional plan, current activities and contacts.

To summarise:

- it is not feasible to provide detailed prescriptive advice for all the circumstances of the industry
- the single best advice is to adopt internationally credible environmental management systems
- there are some issues justifying maximum effort across the industry (see Chapter 3)
- enterprises can adopt simple but comprehensive enterprise environment charters based on the proposed industry environment charter (see Chapter 10, Section 10.2)
- enterprises can use industry and outside training and information services and competitively advantageous systems and tools
- there are general guides available from which site-specific programs can be derived
- the natural resource management regions and catchment authorities covering all areas of Australia are an important source of information and practical support.
11. Implications

The Australian olive industry has accepted the need for continuing action on improving environmental management by incorporating environmental management in its voluntary Code of Practice supporting authenticity and quality in olive products, initially extra virgin oil and later, table olives.

This action parallels increasing attention to the environmental provenance of products and services by others in the supply chain and by consumers.

Every part of the olive industry, from plant nurseries to retailers, depends on a successful olive growing industry, which is in turn dependent on the environment and natural systems.

The industry is therefore vulnerable to changing natural conditions, whether short term, such as natural climate variability, or long term from continuing global changes.

The industry is also vulnerable to changing supply chain arrangements, consumer preferences, input price shocks and regulatory arrangements at a time when environmental considerations are a major and increasing influence on these.

The public reputation of the industry will continue to depend in part on perceptions of its impacts on the environment.

These vulnerabilities can be defended by adopting systems that increase the resilience and adaptability of the industry.

Management systems that deal with whole-of-landscape issues, are regionally connected, require attention to linking issues such as biodiversity, apply to all current and changing land uses and have international credibility, are available and needed. Systems deficient in any of these respects, such as product trading specifications, limit their usefulness and do not improve the industry’s position to the extent needed and possible, and fall short of growing international expectations.

A major problem with environment management systems has been how to accelerate their take up. There are also various supporting arrangements that can be developed to assist enterprises, including overcoming the current information overload and even conflicting advice.

Whatever approaches are adopted must recognise the differences in scale, skills and knowledge, access to resources and surrounding circumstances (economic and social as well as environmental) in the industry.

Investment will be required, including in research and development centred on environmental issues (already commonly the case).

The recommendations in Chapter 12 cover the integrated framework desirable for positive, quick, widespread and continuing action, and more specific issues directed at assisting the industry to adopt improving environmental management, national action to support growers and processors in particular, essential research and development, and ensuring continuing industry action.

A recent extensive analysis of critical success factors for new rural industries has identified seven generic success factors for new rural industries (RIRDC 2009).

Adoption of the recommendations will contribute to these success factors:

- a primary focus on customers and marketing (through recognition of the increasing importance of good environmental practices for consumers)
- a viable source of competitive advantage in the target market (through reduced production costs higher production and differentiation based on ‘green’ credentials)
• industry-wide capability to consistently deliver a product of the required quality (through providing substance to the requirements of the Code of Practice)

• a well-functioning supply chain (through increased consistency across the industry and compliance with trader ‘green’ requirements)

• effective leadership and strategic planning across the industry (through continuing Australian Olive Association commitment and action)

• business proficiency and access to sufficient capital (improved management practices and risk management, both of which appeal to financiers and business partners)

• well-planned, well-managed, adequately funded research and development for the new industry (through participation in the commonwealth levy scheme and making the environment the cornerstone of industry research and development activities).
12. Recommendations

It is recommended that the industry adopt the following framework for successful integration of environmental considerations into every aspect of the olive industry, and as a basis for evaluation of progress:

- **Convince all concerned of the need** – This will involve education and training and continuing information services. It will have common elements, but as with many other elements of a successful program, there will need to be customising to accommodate regional and enterprise differences.

- **Invest in the processes** – It is easier to convince people to act if they can see others are investing in it. This will mean investment by the Australian Olive Association at all levels, and the association seeking to leverage its investment through government and philanthropic sources.

- **Share the gains** – Mechanisms are needed to ensure that those in the industry who actively pursue these issues share in any gains from them.

- **Link environmental action with quality and continuous improvement** – Environmental factors are increasingly a component of quality in the minds of consumers and many other businesses. Continuous improvement processes ensure a sustained effort constantly modified to accommodate new circumstances and knowledge.

- **Secure the natural resource base** – As the industry is totally dependent on natural systems, an obvious starting point is to safeguard the natural assets used on contributing to the industry. This approach provides a sound platform for dealing with the uncertainties inherent in global change issues, thereby increasing the adaptability and resilience of the industry.

- **Constant research** – This will continue to contribute to reducing uncertainties affecting the industry, increasing options available to it, reducing costs and providing a platform for positive relationships with others whose decisions affect the industry.

- **Continuous publicity** – There are promotional, good neighbour and public image gains from regular and positive publicity – within the industry and directed to the outside world.

- **Institutionalise the environmental effort** – This provides commitment, continuous action and support to those in the industry.

- **Supportive government and international policies and programs** – The aim is to influence these and take advantage of them for the benefit of the industry.

Based on the information and analysis in this report, it is recommended that the industry set in train the following detailed actions:

1. **For achieving a progressive industry policy:**
   
   (a) adopt the environment charter presented in Chapter 8
   
   (b) within the overall goal of reducing the industry’s impact on the environment, adopt as major goals:
       - continuing reduction in fossil-fuel use through energy efficiency and use of renewable energy sources
       - an increasingly carbon and biodiversity rich landscape
       - zero waste
   
   (c) accept that pursuit of these goals will involve:
       - choosing operational options with least impact on the environment
• using continuous improvement systems
• restoring degraded environments
• avoiding practices with unknown consequences or that may pose a threat to the environment
  (d) adopt an internationally credible environment management system, for example, ALMCS, the national scheme tailored to all scales and types of enterprise, or any equivalent system applying on a local basis

2. For assisting individual enterprises in implementing improving environmental management:
  (a) trial, review and facilitate the adoption of enterprise environment charters as in Chapter 10, Section 10.2
  (b) trial and review examples of the systems and tools in Chapter 6 (risk assessment, extended producer responsibility, monitoring and reporting, and planning)
  (c) review and republish the Australian Olive Association publication, *Organic Olive Management*
  (d) explore the best ways to disseminate information and achieve rapid behavioural change

3. For national action to support enterprise action:
  (a) establish one or more cleaner production networks within the industry
  (b) review and update financial benchmarking and sensitivity analyses for the industry
  (d) develop a national strategy to deal with the ‘olives as weeds’ issue, based on the work already done in several states and the Australian Capital Territory
  (d) engage with governments, catchment management authorities, community organisations and research and education organisations wherever such interaction supports industry aspirations

4. For generating essential research and development activity:
  (a) promulgate research and development outcomes from outside the industry
  (b) make the environment the cornerstone of the industry research and development strategy, because of its fundamental role in quality and production efficiency
  (c) undertake a life cycle assessment for olive products in Australia, taking advantage of the work done in Europe
  (d) give priority to the other topics for research and development in Chapter 9, Section 9.2 (relationship with the environment, supporting environmental management systems, resilience and adaptation, waste, consumer recognition and public good issues)
  (e) pursue the introduction of a national compulsory levy under commonwealth legislation to support research and development

5. For ensuring continuing industry commitment and action:
  (a) institutionalise within the Australian Olive Association continuing progress on environmental issues within the industry by:
  • establishing an Environmental Management Committee
  • investing in an environmental officer
  • inviting participation in a supporting technical advice group from research, industry, government and community interest groups
  • including environmental elements in trade fairs, field days and similar events
• establishing an industry environment monitoring and public reporting system linking environmental management issues with quality, production, occupational health and safety, and public image

• establishing recognition systems, including annual awards for industry members recognising environmental management achievements or community participation in relation to environment issues, and

(b) the Australian Olive Association join the Australian Network of the United Nations Global Compact and the National Packaging Covenant, and identify and consider joining other national and international organisations and programs of potential benefit to the industry.
Appendix 1 – Bibliography of research and reports 2004–2010

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INTRODUCTION

The starting point for assessing the future of the world’s natural and managed terrestrial ecosystems is the recognition that global change is much more than climate change. It is the net effect of the individual and interactive effects of changes in land use, atmospheric composition, biological diversity, and climate change. In regard to the status of these four major drivers of global change, we note that:

- Atmospheric composition is changing. The increases in CO₂ and other greenhouse gases are undisputed and, with the exception of CFCs, they will continue to rise for at least the next several decades.
- Land use is changing. This involves conversions from one type of land cover to another, as well as changes in management practices (such as fertilization, changes from harrowing to zero-tillage, etc.). It also includes changes in availability of surface water and river flows.
- Biodiversity is declining in most regions of the world.
- Climate is probably changing. The Intergovernmental Panel on Climate Change (IPCC) 1995 assessment (IPCC WGI 1995) concludes that human-induced change in the world’s climate is detectable.

Underlying all four drivers are undisputed and dramatic changes in the human population (Fig. 1), in terms of increases in numbers, movements, per capita consumption of natural resources, and technological capacity to access resources.

**Fig 1. Increase in human population.**

The statistics are widely known, but it is important to recognize their significance and to emphasize the following points. Although the most recent United Nations estimates indicate a slight lessening of the rate of increase beyond the middle of the next century, the human population will continue to grow at current rates until then. All assessments agree that there will be no slowing of the population increase through 2050. The U.N. median (most likely) estimate for 2050 is 9.4 billion, an increase through the 1990s of some 80 x 10^9 people per year. The implications of population growth...
change become clearer when one recognizes that the human population has increased threefold since 1900, and that this has been accompanied by a 20-fold increase in the world economy, a 30-fold increase in fossil fuel consumption, and a 50-fold increase in industrial production. The next 50 years will see another twofold increase in human numbers and a five- to 10-fold increase in the world economy.

As a consequence of the inexorable population increase, crop yields will have to increase by >2%, consistently, every year; before the middle of the next century, they will have to increase by >250%. The combination of economic developments and concurrent advances in technology will result in an increased per capita consumption of natural resources. The ecological consequences of these developments will inevitably include further intensification of land use practices and further conversion of natural vegetation to cultivated lands, mostly in areas that are currently marginal for cropping.

Returning to our opening point, changes in atmospheric composition and climate will influence land use. These land use changes will feed back, directly, to both atmospheric composition and climate; the net effects of all these changes (collectively referred to as global change) will be their combined individual and interactive effects.

This paper is based on a synthesis of the first six years of the International Geosphere-Biosphere Programme's (IGBP) Global Change and Terrestrial Ecosystems (GCTE) Project. The synthesis was carried out by >30 scientists, including the GCTE Scientific Steering Committee (SSC), and was based on a large body of research (the GCTE Research Program) involving >1000 scientists and technicians in 44 countries around the world. The synthesis (Walker et al., in press), is due to appear in early 1998. The format of the paper follows a presentation by the first author of the Executive Summary of the synthesis at the annual meeting of the Ecological Society of America, in August 1997. We present here the main findings of the synthesis in three sections: ecosystem responses, the terrestrial carbon cycle, and living with global change.

ECOSYSTEM RESPONSES

Ecosystem responses are most conveniently considered under two headings: ecosystem functioning and vegetation change. The first deals with terrestrial ecosystem interactions with global change, given any particular state of an ecosystem. The second deals with changes in the state of the ecosystem (i.e., in the structure and composition of vegetation) due to global change.

Ecosystem functioning

Much of the initial work on ecosystem physiology has focused on the ecosystem-level effects of elevated CO₂ and on its interactions with other factors. The emerging understanding can be summarized as follows:

- Most whole ecosystems exposed to double CO₂ concentrations show higher peak-season net carbon uptake than those growing at ambient CO₂ concentration. For grasslands, aboveground productivity increased by an average of 16% across all experiments, although the responses of individual grassland communities varied widely, with some being negative (see Fig. 2). The variation in community responses reflects variation in their component species, the interactive effects among species, and the highly interactive nature of the CO₂ response with other environmental factors such as water, nutrient availability, and temperature.
Cold ecosystems, such as tundra and alpine grassland, are the least responsive to elevated CO₂, in some cases showing no growth response and complete acclimation of peak-season gas exchange after a few years. Faster growth in juvenile trees does not indicate whether forests as a whole will sequester more carbon or not.

Two earlier predictions about responsiveness to elevated CO₂ were that (1) C₄ species will respond less than C₃ species; and (2) species with nitrogen-fixing symbionts will show a larger biomass response. In general, neither of these predictions has been consistently confirmed in ecosystem studies.

Also contrary to earlier predictions, litter from plants grown under elevated CO₂ does not necessarily decompose more slowly. The ratio of C:N in litter from plants grown under elevated CO₂ generally is not higher than that from plants grown in ambient CO₂, although there is a great deal of variation among species.

Elevated CO₂ generally increases the allocation of photosynthate to roots, which increases the capacity and/or activity of belowground carbon sinks. Models suggest that some of the increased capacity of belowground sinks may lead to increased long-term soil carbon sequestration, although strong empirical evidence is still lacking.

Herbaceous plants exposed to elevated CO₂ show a reduction in stomatal conductance, which commonly results in reduced loss of soil moisture. This increase in water availability is the dominant driver for increased net carbon uptake in water-limited grassland systems.

There is also a reduction in stomatal conductance in tree seedlings exposed to elevated CO₂, but this does not seem to be the case for mature trees (forests), based on current experimental data sets. Control of hydraulic conductivity in big trees evidently is much less dependent on stomatal conductivity.

Indirect temperature effects will be more significant than direct effects. Direct effects of increased air temperature on plant growth may be smaller than is often expected because of thermal acclimation. However, there will probably be developmental acceleration and stimulation of litter decomposition. Indirect temperature effects are mainly associated with warming of permafrost in the high latitudes, which may cause thermokarst expansion, substantial changes in species composition (toward woody shrubs rather than mosses), and increased nutrient availability.

In some forests, nitrogen deposition is associated with increased Net Primary Productivity (NPP). However, continuous nitrogen loading will lead, in the long term, to changes in species
composition, which may or may not be associated with increased carbon sequestration at the ecosystem level. Continuous nitrogen loading, along with other associated pollutants, could lead, in many cases, to soil acidification with a subsequent decrease in NPP.

- Model results suggest that the combined effect of elevated CO₂, higher temperatures, and nitrogen deposition is to increase nitrogen mineralization and NPP, whereas carbon storage is decreased by increasing soil temperature.

- Tropospheric ozone has negative effects on ecosystem NPP, but elevated CO₂ could potentially ameliorate plant ozone injury for those species that show decreased stomatal conductance at elevated CO₂. There is also the potential for increased UV-B radiation to decrease NPP.

- In general, wherever human activities have a direct, significant impact on water and nutrient cycles and on disturbance regimes, this impact will override any direct CO₂ effects on ecosystem functioning.

Thus far, the work in GCTE and related programs shows that extrapolation from experiments on single plants to the responses of whole ecosystems to global change must be done with considerable care (e.g., Körner 1995). Also, CO₂ will not increase independently, without other changes. In particular, temperatures and atmospheric nitrogen levels will also change, and it is the interactive effects of all three changes that we need to understand. One modeling experiment (Fig. 3) to investigate these interactive effects illustrates how important they can be and also illustrates the importance of differences in models. As research proceeds, changes in other environmental factors will become evident and will need to be included in integrated analyses.

**Fig. 3.** The simulated impact of double CO₂, increased air temperature (+2°C), and atmospheric N deposition (+0.25 g x m⁻² x yr⁻¹) on three sites: a wet Norway spruce site in Sweden (Flakiliden), a dry pine forest in Australia (BFG), and an annual grassland in California (Jasper), using the CENTURY and G'DAY models. (The G'DAY model was not run on the Jasper data).

**Vegetation change**

First-generation models of vegetation change at regional and global scales were based on the assumption that vegetation is in equilibrium with its abiotic environment. These "equilibrium" models quickly found applications in a wide range of impact studies, but such use often led to a misleading concept amongst non-ecologists of vegetation change based on a rearrangement of present biomes, resulting in a sharp transition from one equilibrium distribution of biomes to another.
The reality is quite different. Impacts on vegetation composition and structure, at scales from the patch to the globe, are occurring now, are continuous, will likely accelerate, and have no identifiable or predictable end point. The understanding emerging from these nonequilibrium, transient dynamics of changing vegetation composition and structure includes several important features:

- Biomes will not shift as intact entities. Species respond differently in competitive abilities (e.g., growth rates), migration rates, recovery from (response to) disturbance, and in other ways. Thus, new combinations of species will arise.

- Paleo studies and model simulations suggest that many plant species can migrate fast enough to keep up with projected climatic change, but only if they can migrate through continuous, relatively undisturbed, natural ecosystems. This emphasises the important consequences of fragmentation of natural ecosystems as a global change phenomenon (Pitelka et al. 1997).

- Invasion of alien species into natural ecosystems is an increasing problem. It is likely to be exacerbated by trends in land use/cover change, by increased globalization of trade, and by increased disturbance.

- Disturbances (e.g., fire, dieback due to insect attacks) appear to be increasing in some regions (e.g., boreal forest), leading to more ecosystems in early successional states (Kurz et al. 1995; see Fig. 4), whereas in other regions (e.g., northern Europe), changes in management have tended to reduce the area of forests in early successional states.

- Markedly different effects of climate change on species composition will occur within individual landscapes, due to local effects of soil, land use, and topographic variation.

**Fig. 4.** The average area of Canadian boreal forest annually disturbed by forest fires, insect-induced stand mortality, and clear-cut logging in the period 1920 -1988 (from Kurz et al. 1995).

When one takes all of these factors together, some generalizations about vegetation dynamics in the 21st century begin to emerge:

- Because of changes in land use, the terrestrial biosphere of the 21st century is likely to be further impoverished in species richness and substantially "reorganized" in species composition, with as yet unknown consequences for ecosystem functioning.

- Disturbance and dieback will probably increase as more long-lived organisms (trees) are further from their optimal environmental envelopes and subject to increasing pressure from land use change.

- More natural ecosystems will be in an early successional state, given the projected increase in disturbance, or will be converted into human-dominated terrestrial production systems. These trends will result in a generally "weedier," structurally simpler biosphere with fewer systems in a more ecologically complex old-growth state.
THE TERRESTRIAL CARBON CYCLE

The potential for terrestrial ecosystems to absorb significant amounts of CO₂, thus slowing the buildup of CO₂ in the atmosphere and reducing the rate of climate change, is a key issue in the debate on CO₂ emission controls. The current understanding of the global carbon cycle, based on a budget of known sources and sinks of CO₂ for the 1980s, is shown in Table 1.

Table 1. Average annual budget of CO₂ perturbations for 1980-1989 (from Schimel 1995). Fluxes and reservoir changes of carbon are expressed in 10^{12} kg/yr (= Gt/yr). Numbers are from IPCC (1994), in addition to estimates for terrestrial sink terms from Schimel.

<table>
<thead>
<tr>
<th>CO₂ budget</th>
<th>10^{12} kg/yr</th>
<th>Error*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂ sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions from fossil fuel combustion and cement production</td>
<td>5.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Net emissions from changes in tropical land use</td>
<td>1.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Total anthropogenic emissions</td>
<td>7.1</td>
<td>1.1</td>
</tr>
<tr>
<td>CO₂ sinks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage in the atmosphere</td>
<td>3.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Oceanic uptake</td>
<td>2.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Uptake by Northern Hemisphere forest regrowth</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>CO₂ fertilization</td>
<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>N deposition</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>Residual (source)</td>
<td>(0.2)</td>
<td>(2.0)</td>
</tr>
</tbody>
</table>

*Errors are accumulated by quadrature.

This analysis suggests that the terrestrial biosphere was about in balance with regard to the emission and absorption of CO₂ for that period, a conclusion supported by recent measurements of atmospheric O₂ concentrations (e.g., Heimann 1997). An estimated 1.6 x 10^{12} kg/yr (1.6 billion metric tons) of carbon were released through land use change in the tropics, whereas about 2.1 x 10^{12} kg/yr of carbon were absorbed by terrestrial ecosystems, through the combined effects of forest regrowth, CO₂ fertilization, and nitrogen deposition. This increase in the size of some terrestrial carbon pools has been demonstrated for a number of locations, but has not been proven at a global scale or over the full vegetation disturbance cycle. It is likely that the increase is thinly distributed over a wide range of ecosystems and, thus, is hard to detect. The crucial question is whether or not this current capability of the terrestrial biosphere to absorb CO₂ can be maintained or increased in the future.

Prediction of future scenarios is difficult because the terms in Table 1 cannot be projected reliably into the future. There are already large uncertainties associated with the perturbation budget of the 1980s, and even larger uncertainties would apply to specific projections for the future. However, it is possible to assess the likely trends in the terms of the budget, whether they will increase or decrease in relative importance, so that an overall trend can be projected.

Land use/cover change

As described in the Introduction, with the human population rising by about a billion per decade over the next three decades at least, sustained increases in food production of > 2% per year will be required. According to projections from the IMAGE model (Alcamo 1994) and from other analyses, this will result both in further conversion of natural ecosystems to agriculture, especially in Africa and Asia (see Fig. 5), and in intensification of production on currently cropped lands. Both of these processes almost always accelerate release of carbon to the atmosphere, so the overall rate of emission from this source will at least be maintained at current levels, or, more likely, will increase. In addition, as more land is converted to agriculture, there is less area in natural ecosystems that can act as carbon sinks, thereby reducing the potential sink strength of the terrestrial biosphere.
Changes in ecosystem structure

Changes in the composition and structure of ecosystems are driven by a combination of management practices (including lack of management practices) and changes in climate and atmospheric composition. For example, the biomass increases currently observed in many forested areas largely reflect successional changes due to past changes in forest management. Future global change effects will be superimposed on these present trends. In particular, the current trend of biomass increases may be reversed in some areas as the effects of global change become increasingly important. Under global change, present vegetation assemblages, rather than shifting as intact biomes, will probably change through increased mortality of some of their components, followed by establishment and growth of new assemblages. Mortality of the present vegetation, which releases carbon to the atmosphere, is a fast process, whereas the growth of a new assemblage of vegetation, which absorbs carbon from the atmosphere, is slower. Thus, the processes by which ecosystem structure and composition change will probably lead to increasing emissions of carbon to the atmosphere on a time scale of decades to centuries, irrespective of whether the new theoretical equilibrium biome distribution (assuming some stable future climate) eventually stores more or less carbon than the present distribution.

Ecosystem physiology

Specific physiological factors likely to affect the long-term carbon balance of terrestrial ecosystems include:

Soil emissions. Oxidation of soil organic matter is predicted to increase with rising temperatures. Observations from the high latitudes, where continental areas have been subjected to a temperature increase over the past three decades, suggest that some tundra ecosystems in Alaska and Siberia have gone from being carbon sinks to sources, or are in approximate balance, largely due to increasing decomposition of soil carbon. However, much more work, such as a coordinated set of warming experiments across several biomes, is required before the potential significance of soil emissions as an emerging source of CO₂ can be confirmed.

CO₂ fertilization/N deposition. A synthesis of the most recent ecosystem-level CO₂ research indicates that the effect of CO₂ on ecosystem functioning, although still potentially significant, is not as large as earlier thought. The interactive effects of land use change (abandonment of agriculture to forests), N deposition, and CO₂ fertilization have led to strong growth in many temperate forests, with evidence that N deposition has played a major role (e.g., Auclair and Bedford 1995). However, the N deposition effect has a definite maximum, and it appears that it is being exceeded for some European forests (Schulze 1989).

Nutrient limitations. The carbon cycle is closely and necessarily linked, at multiple time scales, to the cycles of other nutrients, particularly nitrogen, phosphorus, and sulphur (Rastetter et al. 1997). Insufficient nutrient supply limits ecosystem-level carbon uptake and storage in many systems,
thus attenuating the effects of increasing atmospheric CO₂ and changing climate. In some biomes, increasing temperatures will result in increased N mineralization, which, on its own, would lead to enhanced CO₂ uptake, at least in the short term.

**Physiological "saturation."** The net uptake of carbon from the atmosphere through ecosystem physiology is a balance between the assimilation of CO₂ via photosynthesis and the release of CO₂ through respiration and decomposition. These processes occur at different rates. Carbon assimilation responds positively and almost instantly to increased atmospheric CO₂, whereas the process of decomposition responds only indirectly, through changes in temperature, moisture, and litter quality, all of which include long delay components. In addition, there are nonlinearities in these processes. Although carbon assimilation increases with increasing atmospheric CO₂, it does so at a diminishing rate. Respiration, on the other hand, is an exponentially increasing function of temperature. Thus, as global change proceeds, the rate of increase of CO₂ assimilation by terrestrial ecosystems will slow, while rates of both respiration and decomposition will increase. In the short term, there will be a positive effect on growth and, therefore, on CO₂ uptake, but over longer time frames (centuries), the net effect will be a decrease in the ability of the terrestrial biosphere to absorb CO₂.

**Overall trend**

The terms in the terrestrial carbon budget do not operate independently or on the same time scales, features that make it difficult to extrapolate from knowledge of the dynamics of one budget term over short time scales to long-term trends in carbon storage. The concept of Net Biome Productivity, NBP (Schulze and Heimann, in press), is a useful tool to integrate the effects of several processes over multiple time scales (Fig. 6).

**Fig. 6.** Terrestrial ecosystems carbon uptake and storage.

GPP, Gross primary production; NPP, Net primary production; NEP, Net ecosystem production; NBP, Net biome production.

In addition, the terms in the budget do not operate with the same strength in all regions of the world. In some regions, such as sub-Saharan Africa and large parts of Asia, the land use change component is likely to dominate, and these regions will be net sources of carbon. For others, such as parts of North America and Europe, the carbon sequestration processes may dominate and these regions may remain, or become, significant carbon sinks on a decadal or century time frame.

Given the difficulty in estimating the future (or even present) magnitudes of processes that sequester carbon (e.g., N deposition, CO₂ fertilization) vs. those that release carbon (soil organic matter oxidation, ecosystem structural change), there are many possible scenarios for the terrestrial carbon cycle at a global scale over the next 100 years. However, there is little doubt that, for the next several decades at least, more areas of natural ecosystems will be converted to agriculture, simultaneously emitting carbon and reducing the amount of land on which significant amounts of carbon can be sequestered. Thus, the overall conclusion of the GCTE synthesis is that the present rate of absorption of carbon from the atmosphere, on a global scale, will be difficult to maintain. It is more likely that the terrestrial biosphere as a whole (that is, including land converted or modified for production of food and fiber) will become a net source. This projection has significant implications for the development of strategies to stabilize the concentration of greenhouse gases in the atmosphere.
LIVING WITH GLOBAL CHANGE

Managed production systems

The need to meet a 2% per annum or greater increase in food demand will put enormous stresses on managed production systems. Climatic change will probably further stress these systems. Extreme weather events, such as back-to-back droughts in one, or simultaneous droughts in two or more, of the world’s major grain-producing areas would create severe food shortages. (The extended drought in the mid-U.S. grain region in the 1930s caused massive environmental and economic damage).

One response to the food supply issue is technology: the development of improved cropping systems and/or crop varieties. There is no doubt that improved varieties, such as genetically engineered crops with in-built insecticides and short-season varieties with high water use efficiencies, will offset some of the increased demand. However, biotechnology has not yet succeeded in improving our capability to cope with complex, system-level problems such as drought and salinity. A sustained increase in global production of the required 2% per year will almost surely be achieved, but it will have considerable impact on land use and on ecosystems in general. Climate change makes the task of producing the additional food and fiber more uncertain.

The availability of resources will continue to constrain agricultural development in many regions. For example, water availability, already a major problem, is likely to become increasingly limiting as agricultural, industrial, and urban demands for water compete more directly with the need to maintain river flows for conservation and waste removal and purification purposes.

In terms of the impacts of global change on terrestrial production systems, and the implications for regional and global food supply, work over the past six years has highlighted the following major issues:

- **Crop production.** Crop production will be affected very differently in different parts of the world (as already highlighted by other recent assessments). Recent estimates indicate increases in yield at mid and high latitudes, but decreases at low latitudes, where food demand will be greatest.

Under ideal field conditions, wheat yields are unlikely to increase by more than about 10% for a doubled current CO$_2$ concentration; a 5-7% increase is more realistic for average management conditions (Pinter et al. 1996). Major wheat models are being rapidly refined, but caution is still needed in spatial extrapolation using any single model (see Table 2).

**Table 2.** Maximum and minimum estimates of wheat yield (1 Mg = 1 metric ton) by eight models from the GCTE Wheat Network. Models simulated the growth of hypothetical wheat crops using common weather data sets and the same time course of leaf area index (LAI) development. (From Goudriaan et al. 1994).

<table>
<thead>
<tr>
<th></th>
<th>Day of year of anthesis</th>
<th>Day of year of maturity</th>
<th>LAI (m$^2$/m$^2$)</th>
<th>Total aboveground dry mass (Mg/ha)</th>
<th>Grain dry mass (Mg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crookston, Minnesota, USA (spring wheat)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescribed</td>
<td>183</td>
<td>216</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>182</td>
<td>215</td>
<td>4.5</td>
<td>10.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Maximum</td>
<td>187</td>
<td>216</td>
<td>4.5</td>
<td>16.1</td>
<td>8.8</td>
</tr>
<tr>
<td><strong>Lelystad, The Netherlands (winter wheat)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescribed</td>
<td>166</td>
<td>207</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>164</td>
<td>204</td>
<td>7.5</td>
<td>13.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Maximum</td>
<td>166</td>
<td>207</td>
<td>7.5</td>
<td>26.4</td>
<td>12.1</td>
</tr>
</tbody>
</table>

Temperatures $>$32°C reduce rice yields due to spikelet sterility. This relationship is unaffected by elevated CO$_2$. Major rice models agree across a wide range of potential yields and suggest about a 5% reduction in yield per 1°C rise for temperatures $>$ 32°C (see Fig. 7).
Pests, diseases, and weeds currently cause losses of between one-third and one-half of crop production. Climate change is likely to cause a spread of tropical and subtropical species into temperate areas and to increase the activities of species currently limited by thermal accumulation at higher latitudes.

• **Pastures and rangelands.** The crop/rangeland boundary will encroach on grazing lands in developing countries due primarily to population pressure. Changes in rangeland livestock production will be dominated by a reduction in land area due to cropping and to changes in evapotranspiration and precipitation. A doubling of current CO₂ will increase production in different pastures and rangelands by 0% to 20%, depending on temperature, water, and nutrient limitations. A sensitivity analysis for one subtropical pasture indicated that a 5% increase in pasture growth due to CO₂ would lead to a 3% increase in long-term mean liveweight gain in cattle by reducing the variability of NPP between years.

• **Managed forests.** Short-term studies of elevated CO₂ in managed forests show an increase in plant biomass production by young trees grown under fertile conditions. This increase, however, will be reduced in the longer term as an effect of increased net ecosystem respiration. This reduction may be substantially compensated for by interactive effects of CO₂ and atmospheric nitrogen deposition; the net effect is uncertain.

• **Soils.** The main control on soil organic matter (SOM) levels and erosion over the next few decades will continue to be land management, but changes in vegetation cover due to near-term changes in climate variability will be significant, especially in semiarid regions. A longer term increase in mean temperatures will accelerate SOM oxidation, especially where it allows new land to be brought into cultivation. Soil erosion increases linearly with mean precipitation, but nonlinearly with wind speed, with a threshold for rapid and significant increase in wind erosion at about 5.5 m/s (see Fig. 8).
Fig. 8. Sensitivity of soil erosion in the U.S. corn belt to climate change, as estimated using the model EPIC. Each point represents the 100-yr average of 100 randomly selected sites.

Biodiversity

A strong consensus emerging from a recent analysis of future biodiversity trends in the major biomes of the world (Sala and Chapin, in preparation) identified the main cause of biodiversity loss in the coming decades as land use change, mainly loss of habitat and landscape fragmentation. The next most important factor identified was invasion by alien species. Although trends are less certain here, the general conclusion is that alien species will be an increasing problem, given (1) the globalization of economies and, hence, the movement of people and materials; and (2) the susceptibility of disturbed ecosystems to invasions. Changes in atmospheric composition and climate are regarded as longer term factors, increasing in relative importance over time. However, changes in N deposition have important impacts in shorter time frames on species diversity, particularly in plants, especially in the developed world.

CONCLUDING COMMENT

Global change is occurring now, will continue for the foreseeable future, and is likely to intensify in many aspects. It is an emerging reality that will increasingly impact on the political process, on regional strategic planning, and on the daily lives of resource managers. Learning to live with global change, to avoid the worst hazards and capitalize on opportunities as they arise, requires creative and innovative strategies. These must be built upon a sound, scientific understanding of terrestrial ecosystem interactions with global change.

How can, or should, society use current scientific understanding in responding to global change? An example of this difficulty is the current debate on the "take action now vs. take action later (or take no action)" proposals to limit greenhouse gas emissions. Some global processes have lag times of decades or even centuries. Thus, the consequences of taking no action now may not be felt until the middle of next century, but when these consequences do occur, they could be serious and very difficult to cope with. An example of such a lag effect is the diminishing ability of the terrestrial biosphere to absorb carbon as both atmospheric CO₂ concentrations and temperatures increase. A lack of action now could lead to a large, unavoidable, additional CO₂ release a century or so from now, through increasing decomposition of soil organic matter (about twice as much carbon is stored below ground than above in terrestrial ecosystems).

The bottom line is that we will probably never be able to predict, with a high degree of certainty, precisely how terrestrial ecosystems will interact with accelerating environmental change. Thus, the analogy that ecosystems can be "managed" in the same way that much simpler human-designed industrial systems can, is misleading and dangerous. In terms of terrestrial ecosystem interactions with global change, we must expect the unexpected (and unpredictable) and keep open as many response options as possible. There is an inescapable trade-off between resilience and production in agro-ecosystems: the most productive systems are often the simplest, but they are the least resilient to disturbance and perturbation. Highly productive systems are required to feed an expanding population; complex, resilient systems are required to be able to respond to...
future shocks and disturbances, and to continue providing the ecosystem "goods and services" we need.

Note: The longer document prepared at that time about the overview subject matter is available at <www.igbp.net/page/php.?pid=221> (No. 1 The Terrestrial Biosphere and Global Change: Implications for Natural and Managed Ecosystems, B Walker and W Steffen (eds), IGBP 1997).
Appendix 3 – Climate change

The following two extracts and extracts from the March 2010 Bureau of Meteorology–CSIRO assessment provide updates on the state of climate change science.


The most significant recent climate change findings are:

**Surging greenhouse gas emissions:** Global carbon dioxide emissions from fossil fuels in 2008 were nearly 40% higher than those in 1990. Even if global emission rates are stabilized at present day levels, just 20 more years of emissions would give a 25% probability that warming exceeds 2°C. Even with zero emissions after 2030. Every year of delayed action increase the chances of exceeding 2°C warming.

**Recent global temperatures demonstrate human-based warming:** Over the past 25 years temperatures have increased at a rate of 0.19°C per decade, in every good agreement with predictions based on greenhouse gas increases. Even over the past ten years, despite a decrease in solar forcing, the trend continues to be one of warming. Natural, short-term fluctuations are occurring as usual but there have been no significant changes in the underlying warming trend.

**Acceleration of melting of ice-sheets, glaciers and ice-caps:** A wide array of satellite and ice measurements now demonstrate beyond doubt that both the Greenland and Antarctic ice-sheets are losing mass at an increasing rate. Melting of glaciers and ice-caps in other parts of the world has also accelerated since 1990.

**Rapid Arctic sea-ice decline:** Summer-time melting of Arctic sea-ice has accelerated far beyond the expectations of climate models. This area of sea-ice melt during 2007-2009 was about 40% greater than the average prediction from IPCC AR4 climate models.

**Current sea-level rise underestimates:** Satellites show great global average sea-level rise (3.4 mm/yr over the past 15 years) to be 80% above past IPCC predictions. This acceleration in sea-level rise is consistent with a doubling in contribution from melting of glaciers, ice caps and the Greenland and West-Antarctic ice-sheets.

**Sea-level prediction revised:** By 2100, global sea-level is likely to rise at least twice as much as projected by Working Group 1 of the IPCC AR4, for unmitigated emissions it may well exceed 1 meter. The upper limit has been estimated as – 2 meters sea-level rise by 2100. Sea-level will continue to rise for centuries after global temperature have been stabilized and several meters of sea level rise must be expected over the next few centuries.

**Delay in action risks irreversible damage:** Several vulnerable elements in the climate system (e.g. continental icesheets. Amazon rainforest, West African monsoon and others) could be pushed towards abrupt or irreversible change if warming continues in a business-as-usual way throughout this century. The risk of transgressing critical thresholds (“tipping points”) increases strongly with ongoing climate change. Thus waiting for higher levels of scientific certainty could mean that some tipping points will be crossed before they are recognized.

**The turning point must come soon:** If global warming is to be limited to a maximum of 2°C above pre-industrial values, global emissions need to peak between 2015 and 2020 and then decline rapidly. To stabilize climate, a decarbonized global society – with near-zero emissions of CO2 and other long-lived greenhouse gases – need to be reached well within this century. More specifically, the average annual per-capita emissions will have to shrink to well under 1 metric ton CO2 by 2050. This is 80-95% below the per-capita emissions in developed nations in 2000.

www.copenhagendiagnosis.com
The IPCC’s Fourth Assessment Report (AR4) is an outstanding source of information on our current scientific understanding of the climate system and how it is responding to the changes in the atmospheric concentration of greenhouse gases caused by human activities. In particular, the AR4 provides an excellent overview on issues where there is strong agreement, and points towards those issues where further research is required. But climate science is a rapidly moving field as researchers respond to the challenges laid out by the IPCC and the needs of governments and other groups for even better knowledge about climate change. Over the past three to four years, many new developments have occurred and many significant new insights have been gained. The most important of these are:

• The climate system appears to be changing faster than earlier thought likely. Key manifestations of this include the rate of accumulation of carbon dioxide in the atmosphere, trends in global ocean temperature and sea level, and loss of Arctic sea ice.

• Uncertainties still surround some important aspects of climate science, especially the rates and magnitudes of the major processes that drive serious impacts for human societies and the natural world. However, the majority of these uncertainties operate in one direction – towards more rapid and severe climate change and thus towards more costly and dangerous impacts.

• The risk of continuing rapid climate change is focusing attention on the need to adapt, and the possible limits to adaptation. Critical issues in the Australian context include the implications of possible sea-level rise at the upper end of the IPCC projections of about 0.8 m by 2100; the threat of recurring severe droughts and the drying trends in major parts of the country; the likely increase in extreme climatic events like heatwaves, floods and bushfires; and the impacts of an increasingly acidic ocean and higher ocean temperatures on marine resources and iconic ecosystems such as the Great Barrier Reef.

…climate science is a rapidly moving field as researchers respond to the challenges laid out by the IPCC and the needs of governments and other groups

• Climate change is not proceeding only as smooth curves in mean values of parameters such as temperature and precipitation. Climatic features such as extreme events, abrupt changes, and the nonlinear behaviour of climate system processes will increasingly drive impacts on people and ecosystems. Despite these complexities, effective societal adaptation strategies can be developed by enhancing resilience or, where appropriate, building the capacity to cope with new climate conditions. The need for effective reduction in greenhouse gas emissions is also urgent, to avoid the risk of crossing dangerous thresholds in the climate system.

• Long-term feedbacks in the climate system may be starting to develop now; the most important of these include dynamical processes in the large polar ice sheets, and the behaviour of natural carbon sinks and potential new natural sources of carbon, such as the carbon stored in the permafrost of the northern high latitudes. Once thresholds in ice sheet and carbon cycle dynamics are crossed, such processes cannot be stopped or reversed by human intervention, and will lead to more severe and ultimately irreversible climate change from the perspective of human timeframes.

The executive summary figure illustrates why Lord Nicholas Stern (2009) has referred to climate change (in economic terms) as “…an externality like none other”, and further commented that “…risks, scales and uncertainties (associated with climate change) are enormous. There is a large probability of a devastating outcome”. Ross
Garnaut (2008) has called climate change “a diabolical policy problem”. Policy and economics are obviously central to responding to the climate change challenge, but the biophysical sciences will continue to play an essential, central role in characterising the climate change threat and in shaping effective solutions.
March 2010 Bureau of Meteorology – CSIRO Assessment

State of the Climate

This snapshot provides observations and analysis of Australia’s climate and the factors that influence it. Two organisations, CSIRO and the Australian Bureau of Meteorology have combined to present this current picture of Australia’s climate.

The Bureau of Meteorology has been observing and reporting on weather in Australia for over 100 years, and CSIRO has been conducting atmospheric and marine research for over 60 years.

The snapshot is sourced from peer reviewed data on temperature, rainfall, sea level, ocean acidification, and carbon dioxide and methane levels in the atmosphere.

1. Temperature
Since 1960 the mean temperature in Australia has increased by about 0.7 °C. The long term trend in temperature is clear, but there is still substantial year to year variability of about plus/minus 0.5 °C.

Some areas have experienced a warming of 1.5 to 2 °C over the last 50 years. Warming has occurred in all seasons, however the strongest warming has occurred in spring (about 0.9 °C) and the weakest in summer (about 0.4 °C).

Trend in mean temperature 1960-2009 (°C/decade)

Key Points
• All of Australia has experienced warming over the past 50 years.
• Some areas have experienced warming since 1960 of up to 0.4 °C per decade (see map) resulting in total warming over the five decades of 1.5 to 2 °C.
2. Rainfall
While total rainfall on the Australian continent has been relatively stable, the geographic distribution of rainfall has changed significantly over the past 50 years. Rainfall decreased in south-west and south-east Australia, including all the major population centres, during the same period.

Trend in annual rainfall 1960-2009 (mm per decade)

Key Points
- Trend over five decades of increasing rainfall in many parts of northern and central Australia (see map)
- Trend over five decades of rainfall decreasing across much of southern and eastern Australia (see map)

3. Our Oceans
From 1870 to 2007, the global average sea level rose by close to 200mm. Sea levels rose at an average of 1.7mm per year during the 20th century and about 3.0mm per year from 1993-2009. These levels are global averages and because of the differing movements of ocean currents around the globe, results vary from place to place. This is true for Australia where since 1993 levels have risen 7-10mm per year in the north and west, and 1.5-3mm in the south and east.

Ocean Acidification
The world’s oceans currently absorb about 25 per cent of the carbon dioxide (CO₂) generated by humans – about 40 per cent of this is absorbed in the Southern Ocean. The CO₂ absorbed by the ocean makes the ocean become more acidic. Recent research shows that ocean acidification decreases the ability of marine plants and animals to form shells. Such effects are now being observed at the base of the food chain in the Southern Ocean. This has far-reaching implications for the health of ocean ecosystems around the world.

4. Our Atmosphere
Global CO₂ concentrations have risen rapidly over the last century. Methane, which is another greenhouse gas, has shown similar increases.
The carbon dioxide concentration in 2009 of 386 parts per million (ppm) is much higher than the natural range of 170 to 300 ppm that has existed in the atmosphere for at least the past 800,000 years and possibly the past 20 million years.
5. What this means.

**Australia will be hotter in coming decades**
Australian average temperatures are projected to rise by 0.6 to 1.5 °C by 2030. If global greenhouse gas emissions continue at current levels, warming is projected to be in the range of 2.2 to 5.0 °C by 2070. Warming is projected to be lower near the coast and in Tasmania and higher in central and north-western Australia. These changes will be felt through an increase in the number of hot days.

**Much of Australia will be drier in coming decades**
In Australia compared to the period 1981-2000, decreases in rainfall are likely in the decades to come in southern areas of Australia during winter, in southern and eastern areas during spring, and in south-west Western Australia during autumn. An increase in the number of dry days is expected across the country, but it is likely that there will be an increase in intense rainfall events in many areas.

**It is very likely that human activities have caused most of the global warming observed since 1950**
There is greater than 90% certainty that increases in greenhouse gas emissions have caused most of the global warming since the mid-20th century. International research shows that it is extremely unlikely that the observed warming could be explained by natural causes alone. Evidence of human influence has been detected in ocean warming, sea-level rise, continental-average temperatures, temperature extremes and wind patterns. CSIRO research has shown that higher greenhouse gas levels are likely to have caused about half of the winter rainfall reduction in south-west Western Australia.

**Climate change is real**
Our observations clearly demonstrate that climate change is real. CSIRO and the Bureau of Meteorology will continue to provide observations and research so that Australia’s responses are underpinned by science of the highest quality.

Appendix 4 – The Walmart 15 questions

Supplier Sustainability Assessment: 15 Questions for Suppliers

**Energy and Climate: Reducing Energy Costs and Greenhouse Gas Emissions**
1. Have you measured your corporate greenhouse gas emissions?
2. Have you opted to report your greenhouse gas emissions to the Carbon Disclosure Project (CDP)?
3. What is your total annual greenhouse gas emissions reported in the most recent year measured?
4. Have you set publicly available greenhouse gas reduction targets? If yes, what are those targets?

**Material Efficiency: Reducing Waste and Enhancing Quality**
1. If measured, please report the total amount of solid waste generated from the facilities that produce your product(s) for Walmart for the most recent year measured.
2. Have you set publicly available solid waste reduction targets? If yes, what are those targets?
3. If measured, please report total water use from facilities that produce your product(s) for Walmart for the most recent year measured.
4. Have you set publicly available water use reduction targets? If yes, what are those targets?

**Natural Resources: Producing High Quality, Responsibly Sourced Raw Materials**
1. Have you established publicly available sustainability purchasing guidelines for your direct suppliers that address issues such as environmental compliance, employment practices and product/ingredient safety?
2. Have you obtained 3rd party certifications for any of the products that you sell to Walmart?

**People and Community: Ensuring Responsible and Ethical Production**
1. Do you know the location of 100 percent of the facilities that produce your product(s)?
2. Before beginning a business relationship with a manufacturing facility, do you evaluate the quality of, and capacity for, production?
3. Do you have a process for managing social compliance at the manufacturing level?
4. Do you work with your supply base to resolve issues found during social compliance evaluations and also document specific corrections and improvements?
5. Do you invest in community development activities in the markets you source from and/or operate within?

Source: [http://walmartstores.com/download/3863.pdf]
Appendix 5 – Extract from RIRDC publication no. 08/145

Executive Summary from N Quinn, 2009, *Environmental Management Systems – Analysing known and likely outcomes of current EMS activities*, RIRDC publication no. 08/145, Rural Industries Research and Development Corporation, Canberra.

This report provides a basic description of environmental management systems (EMSs), the Commonwealth Government programmes supporting their adoption, some analysis of the outcomes so far of those programmes and some recommendations for improvement in development and application of such systems. The aim is to provide a foundation for:

- a clearer sense of preferable pathways to success
- testing the value of the different approaches for further investment or development, for providing a sound basis for environmental improvement, for reducing production and landscape management costs and for contributing to quality of product and food safety
- consideration of policy and programme development at Government, region, industry and enterprise level, and reduction of risk of misguided investment by all concerned, and of frustration by participants.

The report is intended to be of benefit to all responsible for policy development and programme management in government, those who have been involved in the Commonwealth funded programmes and those who are active contributors in any way to these programmes or attendant arrangements, including landholders, other researchers and other programme managers and businesses that might benefit from well directed EMS activity in Australia.

There has been considerable detailed reporting of the progress of the programmes, but little analysis of how this progress relates to original intentions or of how the approaches might be modified to achieve better longer-term outcomes from environmental, business and public policy perspectives.

The report was prepared by drawing on many years of direct participation in national and international research, policy and programme development and management related to environmental issues, on participation in Pilots and Pathways Programmes events and related conferences and review of the detailed reports produced in the course of the programmes and of literature about other experience in Australia and overseas. This included concepts underpinning environmental management and other programmes that might be able to be linked with environmental management systems to increase their effectiveness and efficiency.

The *National Framework for Environmental Management Systems (EMS) in Agriculture*, the foundation of the Commonwealth funded programmes, was based on ISO 14001, the international standard for EMSs applicable in Australia. ISO 14001 was developed in an international process to overcome confusion and conflict arising from a proliferation of competing systems. More than 170 countries accept the standard.

ISO 14001 enshrines a continuous improvement process based on planning, acting, checking and review, with the primary environmental objectives beyond compliance with the law and avoidance of pollution being left to the enterprise to determine.

In practice, most of the funded projects under the Programmes have not used ISO 14001 as the basis for their activities, preferring other approaches such as Best Management Practice, environmental assurance, performance standards and meeting regulatory and perceived consumer expectations.

The Commonwealth has not overtly changed its policy, but has increasingly funded projects that are not, or are unlikely to be, based on ISO 14001.
The major purpose of EMSs is to improve environmental management. Their application will usually bring other benefits, such as:

- commercial gains from reduced costs and a platform for differential marketing
- a more holistic approach to enterprise planning and management
- increased industry sustainability because of the continuous improvement approach, rather than the static approach inherent in other systems, eg, Best Management Practice or meeting current performance or regulatory standards
- health and safety improvement, particularly if ISO 14001 is used, as it defines the environment as including humans
- a greater capacity to cope with uncertainties
- increased knowledge of the environment in which an enterprise operates, and of natural systems that support it, and
- improved regulatory systems, particularly if incentives for improving environmental performance are used.

There are many risk and environmental issues affecting agriculture. These include declining terms of trade, climate variability and global warming, pests and diseases, local, national and international regulatory pressures, consumer expectations, water use, the use of chemicals and waste generation. EMSs are one tool for reducing the impact of these.

There are several concepts that can be used to underpin improved environmental performance and that fit well with EMSs, particularly where based squarely on ISO 14001. These include business and property planning and management techniques, effective change mechanisms to facilitate a culture of responsiveness to changing circumstances, long-term environmental sustainability indicators (eg, no net loss of biodiversity as a result of human activity), the precautionary principle (in its positive formulation directing action towards preferred outcomes), resilient systems that absorb shocks without changing their essential nature, life cycle analysis, zero-waste goals and quality assurance.

There are many practical issues affecting the take up of EMSs.

The knowledge of natural systems and their relationship to production activities does not seem to be particularly well understood. The greater this knowledge, the more likely it is that an enterprise will seek to deal with environmental management issues as part of its normal operations.

It has been difficult in many situations to make meaningful connections between enterprises and prevailing catchment or regional planning and management for natural resource management.

Some have perceived EMSs as having little relevance to their day-to-day activities, and as being costly and time consuming.

There has not been the level of support systems – training, extension services, useful research outcomes, facilitators and coordinators, supporting material – that are available in other contexts, eg, many landcare and production system activities.

Lack of good change mechanisms, isolation and fear of adverse consequences (eg, discovery of a threatened species in some jurisdictions) have played a part.

One of the most important outcomes of the Programmes has been the work on capturing value from using EMSs. Research in the projects and the reactions of commercial enterprises in Australia and overseas confirms that at the moment the value of EMSs is in reducing costs and providing a basis for differential marketing, and that the prospects for the latter will be increased with an internationally credible voluntary land management certification system.
There are many programmes that can be used to support EMSs and improved environmental management generally. These include Eco-Efficiency Agreements with the Commonwealth, and participation in the National Packaging Covenant and the Greenhouse Challenge. The majority of projects appear not to have taken advantage of these, and the Commonwealth does not seem to have directed attention to them. There are other Commonwealth activities that can be drawn on, including the landcare programmes, FarmBis and the Advancing Agricultural Industries Programme, and many information sources. Similarly, there are resources available from other levels of government and industry organisations.

Few of the funded projects have been squarely based on ISO 14001, with most with primary objectives (not necessarily stated as such) of meeting externally driven performance standards, or of providing information that enterprises can use to improve environmental performance.

There are many gains from the Pilots and Pathways Programmes, including increased environmental awareness, more positive action than there would have been without them, improved tools for introducing and using EMSs and capacity for simplified auditing processes.

There is now much greater clarity about market issues, and a basis for establishing a land management certification system.

Several aspirations from the National Framework have not been met. These include harmonised government policies related to EMS (although it is not clear what this meant), national coordination and development of a consistent approach (there is a proliferation of approaches) and less need for regulation and conflict management. It is too soon to judge whether or not there will be benefits for the regulation issue, but the proliferation of systems reduces the potential.

Many have sought simplified auditing processes. The evidence is that the possibility of cheap, simplified common audits of several systems is remote.

One of the most important outcomes of this research is that the industry organisation-led approaches favoured by the Commonwealth do not produce systems of the kind envisaged in the National Framework, but have been a major influence in the proliferation of systems leading to potentially limited usefulness of many of them.

Some major conclusions to be drawn from the research are:

- progress is greatest where activities are community-led and voluntary
- industry organisation-led approaches by themselves generate proliferation of systems and confusion
- almost any approach generates increased and valuable environmental knowledge, but if this is the aim, there should be different and better ways to pursue it
- the outcomes of even the best system will be less to the extent that there is not a more active linking of property level and catchment scale activities
- a single auditable and certified land management process based on ISO 14001 will have international credibility and be potentially useful for agribusinesses beyond the farm gate
- cost reductions and a platform for differentiated marketing are likely to remain the financial drivers to use EMSs for the foreseeable future
- intrinsic motivation, the key to success in the long-term, should be increased by continuing education on natural systems, their relationship to production and the risks of diminishing the natural resource base through exploitation
- productive alliances or partnerships can include landholders, landcare networks, researchers, government agencies, catchment management authorities and industry organisations
• the prospects for success are greater with a dedicated institutional base with continuing access to appropriate expertise
• use of simplified and least cost tools is necessary
• there has been a substantial drift from the propositions in the National Framework.

There are implications for all the parties involved, eg, industry organisations, governments, landholders, agri-businesses, researchers and catchment management bodies. There is sufficient evidence to support a redirection of effort towards greater consistency to achieve an internationally credible outcome based on ISO 14001 and related support arrangements such as a voluntary land management certification system.

Recommendations for action are:

1. Review
   • the Commonwealth to initiate a review of the National Framework

2. Increased take up of EMS
   • actively encourage the take up of EMS arrangements through the landcare movement and catchment management authorities, reviewing as necessary the conditions for Commonwealth funding so that this is more, rather than less, likely to occur
   • use an industry organisation – catchment management authority – research institution – landcare – volunteer group alliance to review the means of transmission of knowledge

3. Improved incentives
   • accelerate work on overcoming market failure issues with a view to changing the incentives framework to support continuous improvement systems
   • development of a land management certification system and supporting institutional arrangements

4. Improve available resources
   • encourage regulatory authorities at national, State and local government levels to use ISO 14001 EMSs as part of their systems
   • require catchment management authorities to develop and apply mechanisms to translate catchment targets to farm level objectives or goals
   • undertake a stocktake of public and private programmes so that comprehensive information on supporting programmes can be made available to those undertaking EMSs
   • commission the preparation of a legislation register for laws relevant to agriculture, and ensure it is kept up to date, and
   • commission information supporting the more effective application of EMSs through practical application of concepts referred to in this report, and any others that are identified.
Appendix 6 – ALM fact sheet

Implementing the ALM Certification and Approved Systems

Quick facts
- The ALM Group is a not-for-profit organisation established by landholders.
- The Group helps landholders improve environmental outcomes in ways that enable them to be recognised and rewarded for their achievements.
- The Group has developed a certification system (ALMCS) that complies with international management standards, applies whole-of-farm, is catchment linked and externally audited. The Group also has a parallel ‘approved’ system (ALMAS) designed for landholders and rural residential households who may not wish initially to progress to certification.
- For ALMCS accredited trainers help landholders in Farm Ready funded workshops (for eligible primary producers) to develop their Management Plans using a specially designed web-based software program, myEMS. The only cost to landholders is a modest annual certification fee.
- The ALM Group receives funding support from the Australian Government FarmReady program, Elders, Australian Wool Innovation, the Japanese textile firm, Onward Kashiyama, participating landholders and through voluntary contributions. Wool growers with ALM Group certification may receive a price premium from The Merino Company.

Australian Land Management Group

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Contact Information</th>
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<tbody>
<tr>
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<td>Anne Currey</td>
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<td>0414878175 <a href="mailto:anne.currey@almg.org">anne.currey@almg.org</a></td>
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Individuals and organisations can join the Australian Land Management Group (ALM Group) as Members, Associates or as Partners.

**ALM Group Members**

Individuals joining the ALM Group as Members develop and implement the Australian Land Management Certification System (ALMCS) or the Australian Land Management Approved System (ALMAS).

The **ALMCS** is an externally audited, whole-of-property, catchment-linked land management system that complies with the internationally accepted ISO14001 environmental management standard. This option is recommended for most commercial property holders and for other property managers wishing to have their achievements verified by an external accredited auditor.
The ALMAS is a not-certified system more suited to small holdings and where managers wish to have a structured and informed plan but do not wish to have the plan certified.

Individuals who want to be associated with and or support the activities of the ALM Group can join as Associate Members. Associate members pay an annual subscription and are encouraged to get involved in ALM Group activities in ways that reflect their interests and capabilities.

**ALM Group Partners**

Organisations that want to help and benefit from the ALM Group activities join as ALM Group Partners. ALM Group Foundation Partners are Elders, Australian Wool Innovation, North East Catchment Management Authority, Queensland Murray Darling Committee and the Japanese based global textile corporation, Onward Kashiyama.

**How to implement the ALMCS and ALMAS**

The first step is to contact Julia Telford, Anne Currey or Tony Gleeson at the ALM Group (see contact details on the first page). They will register you for a free ALM Group Information Session to be held at a time and place suitable to both you and the ALM Group. Information Sessions are held for groups of landholders rather than for individuals.

Information sessions usually take about two hours and consist of a presentation and discussion of the system and the associated software. They are designed so you can make an informed decision on whether or not to proceed.

**Implementing ALMCS.** It is recommended that commercial or otherwise substantial landholders develop and implement the ALMCS. This involves completing a single ALMCS Development Workshop and annually an ALMCS Implementation Workshop.

- **ALMCS Development Workshop.** The ALMCS Development Workshop is conducted over two days at a local training facility with access to computers and the internet. Working with ALM Group accredited trainers and various support tools, participants develop an ALM Group Management Plan designed to fit their individual requirements and capabilities. Landholders identify activities that have an environmental impact, do a risk assessment and develop Managements Plans to address the highest priority impacts.

- **ALMCS Implementation Workshop.** The second workshop is an ALMCS Implementation Workshop conducted over one and a half days ideally between 3 and 6 months after the Development Workshop and thereafter annually. The first half day is conducted on the property of one of the landholder participants. The aims are to build learning and motivation within the group and to audit progress of the Management Plan for that property. Landholder participants usually are involved in only one on-property review each year. However, the ALMCS requirement is for all properties to have an on-property review at least once every three years. The second day of the ALMCS Implementation Workshop is held at a local training facility enabling each participant to work with an internet connected computer in much the same way as at the Development Workshop.
At the development and implementation workshops time is allocated for a technical activity of interest to landholders beyond those necessary for the development and review of the management plans. This may involve help from someone with particular expertise not covered by the ALM Group trainers.

**Implementing ALMAS.** The steps involved in developing and implementing an ALMAS are similar to those outlined above for the ALMCS. However, the first workshop is held over one day instead of two and the review process is shorter and more flexibly designed to meet the needs and aspirations of participants. ALMAS workshop activities do not lead to certification of a management plan, however, the transition to an ALMCS is not difficult.

**Costs**

The costs of the **ALMCS workshops** are covered for eligible primary producers by the Australian Farm Ready program (2009 to 2012).

To be eligible for the FarmReady Reimbursement Grant, you need to be either a primary producer (farmers, fishers and foresters as defined by the Australian Taxation Office), immediate family member of a primary producer, member of the management team of a primary production enterprise, or an Indigenous land manager.

Most landholders, managers and others involved in the farm business are eligible for a maximum of $1,500 a year plus travel, accommodation and babysitting fees up to $500 per year. For both the ALMCS Development and Implementation Workshops the cost per participant is $1364 which, for eligible primary producers, may be fully refunded by the Farm Ready program. This means that for landholders who can access the Farm Ready program support the only cost is an annual certification cost paid after successfully completing the Implementation Workshop (current certification fees are at the end of this Fact Sheet.). For more detail go to website [www.farmready.gov.au/](http://www.farmready.gov.au/).

Participant costs for **ALMAS workshops** are negotiated on a case-by-case basis. Costs depend a lot on how many participants there are in a workshop group – the more participants, the less the cost per participant. While we are seeking Farm Ready program registration for the ALMAS workshops, we expect that many landholders who take the ALMAS option may not be eligible for Farm Ready support.

**Certification fee**

The ALM Group is responsible for developing and maintaining the management system, the trainers and the tools used in the workshops, delivering workshops, certification, communicating with members, and promoting the system to landholders, natural resource management agencies and agribusiness organisations, both here and overseas. We are also developing third party accreditation arrangements which strengthen the authority of certification.
Elders is a foundation supporter of the ALM Group because they and their clients recognise the world is changing. Increasingly communities and consumers expect more than just quality. They expect producers to conserve the environment as well as produce food and fibre. Elders and their clients adopting the ALMCS accept their responsibility to leave the planet in the best state possible. Additionally, Elders believes that the ALMCS is one of the few systems that can achieve both national and international recognition, a belief underscored by the recent decision by giant Japanese apparel group, Onward Kashiyama, to contribute to further developing and implementing the ALMCS.

The support from Elders, Onward and the Australian Government reflects the fact that the benefits and costs of land-based environmental improvement are widely shared. The annual certification fee reflects the fact that landholders benefit from improving environmental outcomes, and it helps the ALM Group meet its responsibilities and costs in managing the certification schemes. The ALM Group Board has selected a sliding fee structure based on the self-declared gross value of production from the land for which certification applies. The self-declaration must cover all land uses on or directly affecting the area the certification applies to. The landholder responsible for land management is responsible for ensuring the certification is seen to apply to the land for which the certified land management system applies. Where the land is not used for commercial production, for instance for national parks or private conservation lands, a certification fee will be established by the ALM Group in consultation with the property owner/manager.

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<tr>
<th>Gross annual property income</th>
<th>Fee (excluding GST)</th>
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<tr>
<td>&lt; $100,000</td>
<td>$200</td>
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<td>$100,000-$250,000</td>
<td>$300</td>
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<td>$250,000-$500,000</td>
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<td>$500,000-$1 million</td>
<td>$500</td>
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<tr>
<td>$1 million-$5 million</td>
<td>$500 plus 0.05% of gross income between $1 and $5 m</td>
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<tr>
<td>$5 million-$10 million</td>
<td>$2,500 plus 0.03% of gross income from $5 to $10 m</td>
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<tr>
<td>$10 million-$20 million</td>
<td>$4,000 plus 0.02% of gross income from $10 to $20 m</td>
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<tr>
<td>&gt; $20m</td>
<td>By negotiation</td>
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Source: <http://www.almg.org.au/_literature_65058/ALM_FACTS_1_Implementing_ALMCS_and_ALMAS_July_2010>
Appendix 7 – Extract from RIRDC publication no. 09/054


**Australian Landcare Management Systems**

Elders is a major sponsor of ALMS through the ALMS/myEMS Landcare Farming Project. The project is part of the Elders Landcare Farming Partnership, which was launched in Canberra in September 2006 to promote and encourage uptake of environmentally sustainable practices on Australian farms. In this significant development, Elders is sponsoring ALMS as a voluntary certified whole-of-farm catchment linked EMS. The purpose is to extend the adoption of ALMS using the software product myEMS. The purpose of the ALMS/myEMS project is to improve land management in ways that recognise all participating landholders and support organisations. The objectives of the ALMS/myEMS Landcare Farming project are to:

- promote a voluntary Australian land management certification system
- build and maintain ALMS participation
- provide services to ALMS participants
- demonstrate ALMS benefits.

ALMS is a whole-of-farm, catchment-linked and externally-audited environmental management system requiring all three categories of participating landholders (Eucalyptus, Banksia and Grevillia) to comply with internationally recognised management processes codified in the ISO 14001 standards and to provide support for biodiversity conservation. Banksia and Grevillia certifications require landholders also to exchange information with the relevant catchment authority. Grevillea membership requires landholders to have acquired ISO 14001 certification. Different accreditation requirements apply to auditors undertaking audits for the different ALMS membership categories. Auditors undertake a certification audit at the time of application by a landholder to an ALMS membership category and compliance audits apply thereafter.

Over 60 ALMS land management plans externally-audited ALMS environmental management systems have been certified in South Australia, Victoria and Queensland. ALMS gate signs and certificates are now being distributed with a positive response even to this very modest form of recognition. The ALMS Pilot involved landholders in the Eastern Hills and Murray Plains in South Australia and in the North Central Catchment Management Region of Victoria. Forty-nine landholders participated in the pilot with 32 landholders (65 per cent) achieving ALMS Eucalyptus certification. A further ten landholders beyond the ALMS Pilot have achieved ALMS Eucalyptus certification and, before the end of July 2006, an additional thirty landholders were audited against the requirements for ALMS Eucalyptus certification.

ALMS is used to:

- enable landholders to participate in a national whole of farm system for improving environmental management, and hence business management
  - the national and whole of farm features enhance the potential for recognition (capture of benefits) of improved environmental management from communities, consumers and from government
• enable landholders to benefit from the design work that led to ALMS, including the identification of the essential features of ALMS, the development of eligibility criteria and of auditing requirements for ALMS membership, and the development of processes and tools to assist implementation and auditing
  – the essential features of ALMS include compliance with the ISO 14001 standards, catchment-linked, requiring continuous support for biodiversity conservation, across enterprises whole of farm, external auditing and building on the Landcare culture

• facilitate the use of myEMS, a web-based software tool for use in the development, maintenance and auditing of EMS through the alliance of ALMS and myEMS Pty Ltd.

The “Green Dollar forum” convened by the ALMS Group in Canberra canvassed ways to enable greater recognition of the environmental achievements of landholders. Invited speakers included Hans Joehr, Corporate Head of Agriculture at Nestle and President of the Global Sustainable Agriculture Initiative, Gonzalo Jordan, Director of Agribusiness, Fundacion Region, Chile and Mick Keogh, Executive Director, Australian Farm Institute, who strongly put the case for differentiating agricultural products in whatever way possible, including through using environmental attributes in marketing. The Forum was sponsored by Elders, HiFert, National Industry Food Strategy Ltd and the Rural Industries Research and Development Corporation.
Appendix 8 – Ecoil determining boundaries

The following flow charts from the Ecoil project on using life cycle assessment for the eco-production of olive oil cover the steps identified for agriculture, processing, packaging, storage and distribution, and use and end-of-life.

The table following the flow charts indicates the criteria used in determining the boundaries for the project.
<table>
<thead>
<tr>
<th>Process Category</th>
<th>Included</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production, maintenance and replacement of capital equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation of capital goods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production of agricultural inputs (fertilisers, pesticides, herbicides etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation of agricultural inputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water treatment and supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation of personnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main agricultural activities (application of agricultural inputs, irrigation, soil management, cultivation, pruning, olive collection)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing of low quality olives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main processing activities (storage, purification, grinding, oil extraction, bulk oil storage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing stage waste management activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pomace oil extraction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low quality olive processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaging stage processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packed oil storage and distribution stages processors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use and end-of-life stages processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity generation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 7 – System Boundary Definition Criteria*
Appendix 9 – OECD guiding principles for extended producer responsibility (EPR)

The OECD indicates that the “following guiding principles underlie an effective EPR program:

1. EPR policies and programs should be designed to provide producers with incentives to incorporate changes upstream at the design phase in order to be more environmentally sound.

2. Policies should stimulate innovation by focusing more on results than on the means of achieving them - thus allowing producers flexibility with regard to implementation.

3. Policies should take into consideration a life cycle approach so that environmental impacts are not increased or transferred somewhere else in the product chain.

4. Responsibilities should be well defined and not be diluted by the existence of multiple actors across in the product chain.

5. The unique characteristics and properties of a product, product category or waste stream should be factored into policy decisions. Given the diversity of products and their different characteristics, one type of program or measure is not applicable to all products, product categories or waste streams.

6. The policy instrument(s) selected should be flexible and chosen on a case-by-case basis, rather than setting one policy for all products and waste streams.

7. Extension of producer responsibilities for the product’s life cycle should be done in a way to increase communication among the actors in the entire product chain.

8. A communication strategy should be devised to inform all the actors in the product chain, including consumers, about the program and to enlist their support and cooperation.

9. To enhance a program’s acceptability and effectiveness, a consultation of stakeholders should be conducted to discuss goals, objectives, costs and benefits.

10. Local governments should be consulted in order to clarify their role and obtain their advice concerning the program’s operation.

11. Both voluntary and mandatory approaches should be considered with a view on how to best meet national environmental priorities, goals and objectives.

12. A comprehensive analysis of the EPR program should be made (e.g. which products, product categories and waste streams are appropriate for EPR, whether historical products should be included, and the roles of the actors in the product chain).

13. EPR programs should undergo periodic evaluations to ensure that they are functioning appropriately and are flexible enough to respond to these evaluations.

14. Programs should be designed and implemented in a way that environmental benefits are obtained while domestic economic dislocations are avoided.

15. The process of developing and implementing EPR policy and programs should be based on transparency."

Appendix 10 – Commonwealth guidelines for national environment indicators

Each indicator should:

1. serve as a robust indicator of environmental change
2. reflect a fundamental or highly valued aspect of the environment
3. be either national in scope or applicable to regional environmental issues of national significance
4. provide an early warning of potential problems
5. be capable of being monitored to provide statistically verifiable and reproducible data that show trends over time and, preferably, apply to a broad range of environmental regions
6. be scientifically credible
7. be easy to understand
8. be monitored regularly with relative ease
9. be cost-effective
10. have relevance to policy and management needs
11. contribute to monitoring of progress towards implementing commitments in nationally significant environmental policies
12. where possible and appropriate, facilitate community involvement
13. contribute to the fulfilment of reporting obligations under international agreements
14. where possible and appropriate, use existing commercial and managerial indicators
15. where possible and appropriate, be consistent and comparable with other countries’ and state and territory indicators.

Appendix 11 – Proposals for reporting on the environmental performance of the food value chain

Components of the proposed environmental reporting framework for the Australian food industry with objectives and suggested indicators

<table>
<thead>
<tr>
<th>Component</th>
<th>Objective</th>
<th>Suggested Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stewardship of land</td>
<td>Satisfy society’s need for a mix of services</td>
<td>Amount of land ‘held’ combined with the three indicators below</td>
</tr>
<tr>
<td>Productive capacity</td>
<td>No reduction in productive capacity</td>
<td>Under development</td>
</tr>
<tr>
<td>Biodiversity conservation</td>
<td>Maintain/enhance biodiversity</td>
<td>Proportion of land covered by native vegetation in ‘good’ condition</td>
</tr>
<tr>
<td>Cultural services</td>
<td>Maintain/enhance cultural (non-material) services</td>
<td>Under development</td>
</tr>
</tbody>
</table>

Removals from the environment

<table>
<thead>
<tr>
<th>Component</th>
<th>Objective</th>
<th>Suggested Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>Reduce/minimise</td>
<td>Direct energy use (joules)</td>
</tr>
<tr>
<td>Water</td>
<td>Reduce/minimise</td>
<td>Total water use (cubic metres)</td>
</tr>
<tr>
<td>Other</td>
<td>Reduce/minimise</td>
<td>Total material use (tonnes)</td>
</tr>
</tbody>
</table>

Emissions and discharges to the environment

<table>
<thead>
<tr>
<th>Component</th>
<th>Objective</th>
<th>Suggested Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Reduce/minimise</td>
<td>Total greenhouse gas emissions (tonnes of CO₂ equivalent)</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>Reduce/minimise</td>
<td>Total emissions of ozone depleting substances (tonnes of CFC-11 equivalent)</td>
</tr>
<tr>
<td>Ozone Depleting</td>
<td>Reduce/minimise</td>
<td>As appropriate</td>
</tr>
<tr>
<td>Other</td>
<td>Reduce/minimise</td>
<td>Significant discharges to water (tonnes)</td>
</tr>
<tr>
<td>Water</td>
<td>Reduce/minimise</td>
<td>Total amount of solid waste (tonnes)</td>
</tr>
<tr>
<td>Land</td>
<td>Reduce/minimise</td>
<td></td>
</tr>
</tbody>
</table>

1 Each outcome indicator can be accompanied by a list of initiatives taken to address the component. The information will be useful for the sector in question but is not amenable to aggregation along the food value chain.

2 Suitable indicators for these components are not yet developed but are being considered in the *Signposts for Australian Agriculture* project. They can be added to the reporting framework as they become available.

The difficulties of combining results along the food value chain are overcome by having each sector report on its own performance, while requesting comparable information from its suppliers. Guidelines for a consistent approach to environmental reporting by companies or industry organisations are set out below. Four worked examples have been provided: water use in the production of bread, water use in the production of milk chocolate, greenhouse gases emitted in the production of milk chocolate and energy use in the production of milk chocolate.
GUIDELINES FOR CONSISTENT ENVIRONMENTAL REPORTING BY COMPANIES OR INDUSTRY ORGANISATIONS

The following steps are provided as guidelines for consistent environmental reporting by individual companies or industry organisations, using the reporting framework set out in Figure 2 and elaborated in Table 1.

1. Decide on the subject of the report. For example, is it a specific product, all products you manufacture, a class of products such as ‘white bread’ or a broad category such as ‘Australian confectionery’?

2. Identify the sectors that make up the food value chain for the chosen subject. Distinguish ‘your’ sector from those of your suppliers.

3. Generate data for your own sector for one or more of the components in the reporting framework (water, energy, greenhouse gas emissions etc.). This data can be used to prepare a report for an individual sector of the value chain. If you need to report for the whole chain up to and including your sector, continue to Step 4. Otherwise stop here.

4. Determine the amount of product or service you require from each of your suppliers to produce a unit of the chosen subject.

5. Ask each of your suppliers to provide data for the product or service they supply to you following these guidelines up to and including Step 6. You will need to specify the components (water, energy, greenhouse gas emissions, etc) for which you require information.

6. Combine the information obtained in Steps 3, 4 and 5 to generate an environmental report for the chosen subject from the start of the food value chain up to and including your sector.

Conclusions

- There are indications that improved environmental reporting by the Australian food industry, including reporting along the food value chain, will be required in future years.

- The approach used to develop the *Signposts for Australian Agriculture* framework is equally applicable to activities further along the food value chain. The generalised framework is able to accommodate primary production, transport and storage, and processing sectors. It is also reasonable to assume that the framework can be applied as a generalised model to other industries within the agrifood sector.

- Small and medium enterprises are most likely to respond to initiatives that have direct economic benefit to themselves, i.e. initiatives that lead to efficiencies in the use of water, energy and materials. Other drivers such as market advantage and market access are currently weak but, as set out in the Allen report, may become more important in the future.

- Small and medium enterprises are unlikely to engage in data gathering or reporting unless it can be seen to be of direct business benefit, can be integrated into existing reporting arrangements and is accompanied with the right templates and tools.

- There appears to be relatively little focus on a ‘whole chain’ approach in which the environmental performance of the primary production, transport and processing sectors are integrated to provide an overall assessment. Reasons for this include:
− It is a complex undertaking both conceptually and practically.
− Responsibility is spread across many stakeholders and an individual enterprise, particularly a small or medium one, has limited ability to influence all the players.

At both the industry and enterprise level, further development is required to overcome:
− The limited information available on key inputs and emissions;
− The limited incentive for reporting;
− The complexity associated with some business practices and the highly specific inputs and processes in some instances; and
− Application and engagement across the food value chain.

It is possible to develop an environmental reporting framework for the Australian Food Industry by taking into account these findings. The proposed framework, based on the generalised Signposts framework, builds on existing initiatives within the food industry and uses basic indicators common to many reporting systems. The proposed framework uses the chain itself to overcome the difficulties of combining information along the chain. An individual company need concern itself only with reporting on its own performance and requesting corresponding information from each of its suppliers.

Appendix 12 – ICC Business Charter for Sustainable Development

The following 16 principles make up ICC's Business Charter for Sustainable Development. They provide businesses worldwide with a basis for sound environmental management.

1. Corporate priority
To recognize environmental management as among the highest corporate priorities and as a key determinant to sustainable development; to establish policies, programmes and practices for conducting operations in an environmentally sound manner.

2. Integrated management
To integrate these policies, programmes and practices fully into each business as an essential element of management in all its functions.

3. Process of improvement
To continue to improve corporate policies, programmes and environmental performance, taking into account technical developments, scientific understanding, consumer needs and community expectations, with legal regulations as a starting point; and to apply the same environmental criteria internationally.

4. Employee education
To educate, train and motivate employees to conduct their activities in an environmentally responsible manner.

5. Prior assessment
To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site.

6. Products and services
To develop and provide products or services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused, or disposed of safely.

7. Customer advice
To advise, and where relevant educate, customers, distributors and the public in the safe use, transportation, storage and disposal of products provided; and to apply similar considerations to the provision of services.

8. Facilities and operations
To develop, design and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, the sustainable use of renewable resources, the minimisation of adverse environmental impact and waste generation, and the safe and responsible disposal of residual wastes.
9. Research
To conduct or support research on the environmental impacts of raw materials, products, processes, emissions and wastes associated with the enterprise and on the means of minimizing such adverse impacts.

10. Precautionary approach
To modify the manufacture, marketing or use of products or services or the conduct of activities, consistent with scientific and technical understanding, to prevent serious or irreversible environmental degradation.

11. Contractors and suppliers
To promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging and, where appropriate, requiring improvements in their practices to make them consistent with those of the enterprise; and to encourage the wider adoption of these principles by suppliers.

12. Emergency preparedness
To develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with the emergency services, relevant authorities and the local community, recognizing potential transboundary impacts.

13. Transfer of technology
To contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors.

14. Contributing to the common effort
To contribute to the development of public policy and to business, governmental and intergovernmental programmes and educational initiatives that will enhance environmental awareness and protection.

15. Openness to concerns
To foster openness and dialogue with employees and the public, anticipating and responding to their concerns about the potential hazards and impacts of operations, products, wastes or services, including those of transboundary or global significance.

16. Compliance and reporting
To measure environmental performance; to conduct regular environmental audits and assessments of compliance with company requirements, legal requirements and these principles; and periodically to provide appropriate information to the Board of Directors, shareholders, employees, the authorities and the public.

Source: www.iccwbo.org/policy/environment/id1309/index.html
Appendix 13 – Keidanren (Japan Business Federation) Global Environment Charter

Companies must carry on their business activities to contribute to the establishment of a new economic social system for realizing an environmentally protective society leading to the sustainable development.

General management policies

Companies should always consult the guidelines below in carrying on their activities. They must work to (1) protect the global environment and improve the local living environment, (2) take care to protect ecosystems and conserve resources, (3) ensure the environmental soundness of products and (4) protect the health and safety of employees and citizens.

Corporate Organization

- Companies shall establish an internal system to handle environmental issues by appointing an executive and creating an organization in charge of environmental problems.

- Environmental regulations shall be established for company activities, and these shall be observed. Such internal regulations shall include goals for reducing the load on the environment. An internal inspection to determine how well the environmental regulations are being adhered to shall be carried out at least once a year.

Concern for the environment

- All company activities, beginning with the siting of production facilities, shall be scientifically evaluated for their impact on the environment, and any necessary countermeasures shall be implemented.

- Care shall be taken in the research, design, and development stages of making a product to lessen the possible burden on the environment at each level of its production, distribution, appropriate use, and disposal.

- Companies shall strictly observe all national and local laws and regulations for environmental protection, and where necessary they shall set additional standards of their own.

- When procuring materials, including materials for production, companies shall endeavor to purchase those that are superior from such viewpoints as conserving resources, preserving the environment, and enhancing recycling.

- Companies shall employ technologies that allow efficient use of energy and preservation of the environment in their production and other activities.

- Companies shall endeavor to use resources efficiently and reduce waste products through recycling, and shall appropriately deal with pollutants and waste products.
Technology development

In order to help solve global environmental problems, companies shall endeavor to develop and supply innovative technologies, products and services that allow conservation of energy and other resources together with preservation of the environment.

Technology transfers

- Companies shall seek appropriate means for the domestic and overseas transfer of their technologies, know-how and expertise for dealing with environmental problems and conserving energy and other resources.

- In participating in official development assistance projects, companies shall carefully consider environmental and antipollution measures.

Emergency measures

- If environmental problems ever occur as a result of an accident in the course of company activities or deficiency in a product, companies shall adequately explain the situation to all concerned parties and take appropriate measures, using their technologies and human and other resources, to minimize the impact on the environment.

- Even when a major disaster or environmental accident occurs outside of a company's responsibility, it shall still actively provide technological and other appropriate assistance.

Public relations and education

- Companies shall actively publicize information and carry out educational activities concerning their measures for protecting the environment, maintaining ecosystems, and ensuring health and safety in their activities.

- The employees shall be educated to understand the importance of daily close management to ensure the prevention of pollution and the conservation of energy and other resources.

- Companies shall provide users with information on the appropriate use and disposal, including recycling, of their products.

Community relations

- As community members, companies shall actively participate in activities to preserve the community environment and support employees who engage in such activities on their own initiative.

- Companies shall promote dialogue with people in all segments of society over operational issues and problems seeking to achieve mutual understanding and strengthen cooperative relations.

Overseas operations

Companies developing operations overseas shall observe the Ten-Points-Environmental Guidelines for the Japanese Enterprises Operating Abroad in Keidanren's Basic Views of the Global Environmental Problems (April 1990) (see Attachment).
Contribution to public policies

- Companies shall work to provide information gained from their experiences to administrative authorities, international organizations, and other bodies formulating environmental policy, as well as participate in dialogue with such bodies, in order that more rational and effective policies can be formulated.

- Companies shall draw on their experience to propose rational systems to administrative authorities and international organizations concerning formulation of environmental policies and to offer sensible advice to consumers on lifestyles.

Response to global problems

- Companies shall cooperate in scientific research on the causes and effects of such problems as global warming and they shall also cooperate in the economic analysis of possible countermeasures.

- Companies shall actively work to implement effective and rational measures to conserve energy and other resources ever when such environmental problems have not been fully elucidated by science.

- Companies shall play an active role when the private sector's help is sought to implement international environmental measures, including work to solve the problems of poverty and overpopulation in developing countries.

Source: www.keidanren.or.jp/english/speech/spe001/s01001/s01b/guide.html
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Establishment of Environmental Management Systems for the Olive Industry

By Nelson Quinn

Publication No. 11/089

This report analyses the relationship between the olive industry and the natural system in which it operates. The environmental system described in this report underpins the Australian Olive Association’s environmental charter within its Code of Practice.

The report can be used by individual enterprises, suppliers and contractors to the industry, olive industry associations from regional to national level, governments and others who interact with the industry, and research organisations.

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