Australian Government
Land & Water Australia

Futures Thinking

... ABOUT LANDSCAPES, LIFESTYLES AND LIVELIHOODS IN AUSTRALIA

Steven Cork *Land & Water Australia*, Kate Delaney *Delaney and Associates*, David Salt *Ywords*
with input from staff and stakeholders of Land & Water Australia

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GPO Box 2182
Canberra ACT 2601
Phone: 02 6263 6000
Fax: 02 6263 6099
E-mail: <Land&WaterAustralia@lwa.gov.au>
Website: <www.lwa.gov.au>

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Authors:

Steven Cork
Land & Water Australia
GPO Box 2182
Canberra ACT 2601
Phone: 02 6263 6027
Fax: 02 6263 6099
E-mail: <steve.cork@lwa.gov.au>

Kate Delaney
Delaney and Associates Pty Ltd
Suite 6, 84 MacGregor St
Deakin ACT 2600
Phone: 02 6260 3464
E-mail: <kdel1473@bigpond.net.au>

David Salt
Ywords
56 Limestone Avenue
Ainslie ACT 2602
Phone: 02 6248 6972
E-mail: <ywords@netspeed.com.au>

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... ABOUT LANDSCAPES, LIFESTYLES AND LIVELIHOODS IN AUSTRALIA

FOREWORD

There are no facts about the future, although some things are more likely than others. The past tells us that the things that cause us most trouble often come from what we had thought were on or beyond the fringes of possibility.

Land & Water Australia is a research funding body in the Australian Government's Agriculture portfolio. We invest in knowledge, partnerships, innovation and adoption to underpin sustainable natural resource management in Australia. Accordingly, we need to be thinking, planning and scoping research needs across large scales in space and time.

The processes we are dealing with today — be they ecological, hydrological or climatic — will play out over coming decades against backdrops that may look very different from our current assumptions. Further, we should assume that new sustainability challenges will emerge, and we need to apply insight and imagination to envisage some of these possibilities.

This booklet summarises a lot of work by many people both within and outside Land & Water Australia. It draws upon a much larger body of reference and analysis that is captured in a complementary CD-ROM, which you can order through www.lwa.gov.au or freecall 1800 776616.

It was prepared at the instigation of our staff and our Board who requested an analysis of trends and future drivers that will shape natural resource management in Australia.

Land & Water Australia has a tradition of futures thinking, starting with the use of Foresighting in developing our early salinity and vegetation programs, continuing through the Redesigning Agriculture for Australian Landscapes Program, and growing into the Future Landscapes Program over the past three years.

We are very lucky to have been able to draw on the scientific insights and communication skills of Dr Steve Cork, on secondment to Land & Water Australia from CSIRO as our Futures Specialist, to lead us on this excursion into possible futures, and in our futures work more broadly. Steve worked in partnership with futurist Kate Delaney to distil information and opinions from a vast literature to prompt readers to consider possibilities they might not have considered before. We hope to stimulate people to imagine a range of possible futures. For Land & Water Australia, it points us to R&D directions we need to be thinking about now.

The concept of triple bottom line accountability to measure progress towards sustainability has been around for a decade or so. It has made a useful contribution in getting people to think more broadly than straight economic indicators to include social and environmental dimensions in developing a fuller picture of human progress. Building on this concept, I have found it useful to think about rural sustainability in terms of a 'triple helix' of landscapes, lifestyles and livelihoods — interwoven and interdependent like three strands of DNA.

Landscapes are socially constructed, and the ecological capacities and constraints of landscapes in turn shape the sorts of lifestyles and livelihoods people can derive from them. Increasingly, lifestyle choices influence population pressures and resource consumption, and of course people's lifestyles are in turn shaped to a large degree by the need to make a living. The three strands in the 'triple helix' of landscapes, lifestyles and livelihoods are intertwined.

In thinking about how we manage natural resources, we need to remain conscious of the sense of place, of how people make a living, and how they live their lives — and how these interactions may change in a range of possible futures. The interconnectedness of landscapes, lifestyles and livelihoods is woven throughout this document as a metaphor for considering alternative futures in natural resource management.

Dr Steve Cork has taken on the heroic task of distilling an enormous research effort and numerous stimulating discussions and workshops into a readable executive summary, and has done so with patience, understanding and good humour. This is just the tip of the iceberg. Please scan it and check out the background CD-ROM as a valuable reference resource across an extremely diverse literature.

This work has already stimulated new ideas and exciting projects within Land & Water Australia, and I hope this booklet will do so more broadly.

Andrew Campbell
Executive Director
Land & Water Australia

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THE PURPOSE OF THIS DOCUMENT

Land & Water Australia's Future Landscapes Program aims to build capacity for futures thinking among the Corporation's staff and stakeholders, encourage dialogue about the future of natural resource management, and invest in research to prepare Australia for alternative futures.

People have told us that they lack confidence in a dialogue about the future because they don't have what they think is the necessary background knowledge. This is only partly true as most people have a wealth of valuable experience that they don't realise they have. In the last few years, there have been several impressive attempts to generate thinking about the future of natural resources in Australia and the rest of the world. Many of these are cited and reviewed on the accompanying CD-ROM.

The purpose of this document, then, is to build on these past efforts to provide easily accessible background information on past trends and possible future change in Australia, our region and the world. It is not comprehensive and it provides only some of the insights and opinions that are possible. We hope, however, that it will encourage readers to think more broadly about the factors that might determine the future and to imagine for themselves what challenges could emerge.

This brings us to our second purpose. Imagining future challenges is one thing, but thinking about what might be needed to prepare us for them is another. We have made some suggestions about where research and development is needed to address plausible future challenges. We hope you will give us your views as well.

Thus, the main questions we have asked (our focal questions) in doing this work are:

- What social, economic and environmental factors could bring about major change in Australian landscapes, lifestyles and livelihoods over the next 25 years and beyond?
- What research challenges do these possibilities raise?

This document highlights the main points in our analyses. The accompanying CD-ROM contains a longer report with links to a wide range of resources. That report is a work in progress. It is a source document that can be delved into at any point for ideas and for guidance on where to find further information.

KEY POINTS

- We aim to build capacity and confidence for thinking about futures for Australian landscapes, lifestyles and livelihoods
- We suggest where research and development can prepare Australia for the future
- This document and the accompanying CD-ROM provide background information and links to sources
- We hope they will encourage you to read and think about future challenges and opportunities

Our focal questions

What social, economic and environmental factors could bring about major change in Australian landscapes, lifestyles and livelihoods over the next 25 years and beyond?

What research challenges do these possibilities raise?

IDEAS, NOT PREDICTIONS

A range of plausible futures

Futures analysis developed in World War II. It became popular in the business world in the 1960s because methods that attempted to predict a single future usually got important details wrong and often led to unwelcome surprises. Futures thinking and futures analyses acknowledge that the future is mostly unknowable. They seek to explore not just one likely future but a range of plausible futures. Most importantly, they ask 'what do we need to do now to avoid or minimise unwelcome surprises and shocks later'?

Futures thinking uses a range of techniques that harness the power of our experiences and imagination to explore what futures are possible and what we might need to do to prepare ourselves. Uncertainty, shocks and surprise are key concepts for futures thinkers. Futures thinking is most useful for aspects of the future where we are uncertain about what could happen and we have little control over what does happen (see box on page 4). The future relationships between humans and the natural environment are largely uncertain and only partly under our control.

Surprises and shocks, inevitable and otherwise

A key role for futures analysis is separating what is relatively certain from what is uncertain. For example, it is almost certain that some landscapes will continue to become salinised, some soils will continue to erode and degrade, unwanted nutrients will continue to accumulate in waterways, and native species will continue to decline in Australia for several decades. The processes are under way and cannot be reversed quickly or cheaply. It is uncertain, however, how big those rises or declines will be, what policies and social changes might help or hinder, or how successful various solutions will be.

There will be surprises and shocks in the future. But surprises are not all the same. Some technological advances will totally surprise most of us, as the laser did in the 1940s. We underestimate how much of what we now regard as general knowledge came initially as a surprise (see, for example, the 'Ecological Surprises of the 20th Century' box on page 14).

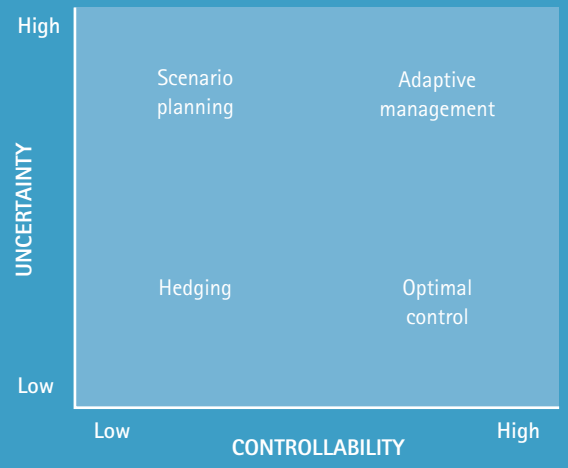
Some surprises cannot be predicted precisely but elements of them are inevitable, according to one of the world's leading futurists Peter Schwartz. To most of us, the explosion of the Internet and mobile messaging, the faltering of the Asian economies, and the outlawing of the communist party in the former Soviet Union came as surprises. In retrospect, however, we realise that things like these were inevitable. Similarly, it is inevitable that our actions in coming decades will have unintended ecological and social impacts, both positive and negative. We need to be very clear what our assumptions and expectations about the natural environment are, and we need to be looking constantly for signs that we might be right or wrong in those assumptions. This is the essence of 'environmental scanning', an integral part of ongoing futures thinking.

KEY POINTS

- Futures thinking takes a structured approach to exploring a range of possible futures rather than predicting a single expected or 'most likely' future
- Imagination, experience and judgement are used to complement analysis of empirical data
- It searches especially for sources of possible welcome or unwelcome shocks and surprises
- Futures thinking is not easy, but we are all capable of it and we all use it in our daily lives

WHERE FUTURES THINKING HELPS MOST

Futures thinking (eg. scenario planning) is not a substitute for all other forms of planning. It is most important where we are uncertain about what might happen in the future and we have little control over it.



Everybody's doing it

For most people futures thinking would not be thought of as a particularly relevant day to day activity. And yet, we all do it all the time whenever we decide to commit resources to a project that will run over several decades. Young families do it when they buy a home. Will their house appreciate over time? Is it located in a good area for their children? Are there any activities planned for this area that may impact on the family?

Farmers do it when they invest in infrastructure for the farm or engage in significant environmental works. Will this investment improve the value of the farm over coming decades? Is there some environmental variable that may prevent this increased value being realised? Will the farmers' children hang around to make the investment worthwhile in the longer term?

Business people do it when deciding how to grow the business. Will their market change in the future? Will the goods and services they depend upon be available in the future? Will technology create competition that may bury them?

Answering all of these questions involves a mix of understanding what has happened in the past, appreciating what trends are opening up now, and imagining what wild cards might appear in the years to come. This is futures thinking and everyone does it to a greater or lesser extent.

No need to fear futures thinking

Futures analysis involves the following steps:

- Identify factors that brought about change in the past
- Identify factors that could bring about change in the future
- Separate what is relatively certain from what is uncertain about the future
- Explore the range of ways in which uncertainties could play out (often using carefully constructed 'stories' or 'scenarios' to test logic and communicate key messages)
- Identify what needs to be done now to prepare for later

Since the 1960s, futures thinking techniques like Foresighting and Scenario Planning have helped businesses steal a lead on their competitors (eg. Shell, Duke Energy, Electricté de France, BHP Billiton, Telstra, Alcatel, Vodafone, KPN Telecom, British Telecom, IBM, General Motors, British Aerospace, Daimler Chrysler Aerospace, US National City Banks, American Century, Federal Express, Levi-Strauss, GE Consumer Finance Australia, Insurance Australia Group, CSC Australia, Uniting Care Ageing Australia).

Richard Slaughter, formerly of the Australian Foresight Institute (<www.afi.edu.au>), says that we are all proficient futures thinkers as individuals, carrying in our heads multiple scenarios about what to do if our days don't go as planned (see 'Everybody's Doing It'), but that organisations are usually poor at futures thinking unless they deliberately invest in developing the skills and capacity.

Despite its documented benefits, futures analysis has a mixed reputation and has not been applied much in natural resource management. This may be because many futures analyses have failed to stimulate participants' thinking enough, so they don't produce new and practical ideas. It is also partly because scientists, environmental managers and policy makers prefer facts to conjecture. But we would be mistaken to think that facts about the present are also facts about the future.

We hope through this document to encourage futures thinking and sharing of ideas among Australians interested in the future of our natural resources.

WHERE HAS AUSTRALIAN NRM COME FROM?

Key events and trends in the past

Knowing about and understanding the past is one key to productive thinking about the future. The CD-ROM gives a summary of some key events in relation to Natural Resource Management in Australia over the past 50 years. This period has seen the role of science and technology in Australian society change substantially (see also the later section on 'The Role of Science').

In the 1950s all things seemed possible for the nation. Science was seen as a way to achieve wealth and improved lifestyles. The sheep industry was boosting the economy, supported by research and development, and the Snowy Mountains Scheme showed our engineering ability.

The 1960s saw big technological changes, like the advent of jet aircraft, and social change along with the Vietnam war and the rise of the peace movement. But faith in science was still there. The role of science in natural resource management largely related to agricultural research and development.

The 1970s saw the first major public environmental conflicts over forests. Science was called on to provide research to solve the conflicts, and funding for ecological research increased. As environmental disputes continued through the 1980s, science continued to play a trusted role. The development of remote sensing and its application to climate research was one highlight.

The 1990s saw an increasing ability of scientists to collect and process the large amounts of data needed to address landscape and ecosystem scale questions. But as the sophistication of lobbying for environment-related issues increased so did the pressure on science to produce unequivocal answers to complex questions. As the expectations rushed ahead of knowledge, the pressure grew to integrate science with other approaches to addressing society's challenges.

A distinctive feature of the 1990s was discussion about how to make research more compatible with policy development. The concept of ecologically sustainable development also caught on in the 1990s. But there was confusion about what sustainability is and the realisation that achieving it would involve a complex set of trade-offs that involved interrelated social and ecological issues.

ONE VIEW OF MAJOR STAGES IN NATURAL RESOURCE MANAGEMENT SINCE THE 1950S*

1950s	1960s	1970s	1980s	1990s	2000s
The age of possibility	The Lucky Country	The emergence of ecological awareness	Natural resources management	Ecologically sustainable development	Complex Interdependencies
Science is authoritative voice		Science as knowledge (answers)	Increasing challenges for science		Integration
National development and 'wise use' of resources (1900–1960s)		Modern environmentalism			
Suburban growth		Communities		Urban renewal	

*Summary a more detailed timeline presented on the CD-ROM

INFRASTRUCTURE REPORT CARD

Analysis of Australia's infrastructure based on fitness for purpose (A is the highest rating, for ratings of D or D– the infrastructure is in a 'disturbing state')*

Category	Rating	Category	Rating
Electricity	B	Airports	B
Gas	C	Roads (National)	C
Telecommunications	B	Roads (State)	C-
Rail	D-	Roads (Local)	D
Ports	B	Potable Water	C
Irrigation	D-	Stormwater	D
Wastewater	C-		

*Source: The Institution of Engineers, Australia (2001). 2001 Australian Infrastructure Report Card. <www.InfrastructureReportCard.org.au>

The state of our assets

Towards the end of the last millennium, our attention was drawn more than ever to assessing the state and value of Australia's assets, including the natural ones. The National Land & Water Resources Audit was one major step in this direction (see box summarising the Audit conclusions). Other reports drew attention to the state of the nation's infrastructure. This became a major focus of the Business Council of Australia's 'Aspire Australia 2050' scenarios (<www.bca.com.au>). Several commentators argue that our environmental futures will be influenced strongly by how serious and clever we are about addressing declines in our natural and built assets.

Science under the spotlight

Trust in science became a topic of debate as the world moved into a 'post-modern' phase in which some questioned whether there were ultimate "truths" and whether science was the way to discover them. At the same time, however, many realised that science has much more to offer than has been recognised. Parts of the scientific community have worked to better connect science with the needs and expectations of society.

With the increasing sophistication and reach of the media through the 1990s and early 2000s, the general public began to understand that environmental and social issues are complex and interrelated. As we move into the new millennium our stakeholders will no longer accept simple answers to these complex problems. The challenge is there for science to adopt "systems thinking" and interdisciplinary approaches to society's burning issues.

Other interpretations of our past are discussed on the CD-ROM.

The condition of Australia's natural resources

The National Land & Water Resources Audit (<www.nlwra.gov.au>) recently assessed the condition of Australia's natural resources. The Audit's major conclusions included:

- many of Australia's resources are in sound condition, but may require protective management in the future;
- Australia's agricultural landscapes have doubled in biological productivity since European settlement;
- Australian soils are viable, but soil erosion is still a major problem in many areas, with different causes in different places;
- some resources have undergone irreversible degradation and loss (eg. extinctions of native plants and animals due to significant changes in the extent and composition of native vegetation systems);
- some are amenable to improvement through known solutions (eg. soil acidity, soil erosion and associated movements of sediment and nutrients into waterways);
- others might require adaptive management (eg. living with salinity in some places);
- some problems may inevitably build up for some time into the future because of processes already in train (eg. increased nutrient loads to estuaries and water ways), but action now should see improvements in the medium to longer term;
- to support on-ground change, Australia also needs:
  - more integrated approaches to the complexities of sustainable land, water and biodiversity management;
  - better access to information on the relationships between farming practices and natural resources condition and responses; and
  - incentives to promote the adoption of improved management.

AUSTRALIA'S CHANGING DEMOGRAPHICS

The CD-ROM summarises a large number and wide range of drivers that potentially will influence the future of natural resource management in Australia. Opinions vary on the strength of some trends and which ones are most important. It also is debatable which factors influence (drive) others and which ones are influenced themselves (driven). In strongly interrelated systems like the 'triple helix' of landscapes, lifestyles and livelihoods, the distinction can be hard to make and may change from time to time and place to place.

The following sections highlight the main influences on landscapes, lifestyles and livelihoods in Australia. Most drivers that we have considered relate to all three headings but fit comfortably under one or another. In this section, we deal separately with changes in the world's populations, in the size and make up of Australia's population, and in where people live and work in Australia, because these have such far-reaching potential impacts.

Population changes

Some elements of population changes (globally and nationally) are relatively certain but others are uncertain. Global population will increase in the next few decades, but there is debate about how much. The increase will inevitably be more in the developing than the developed world, potentially leading to greater influence from developing countries as both consumers and innovators. Already we see countries like India and China coming up with many technological and organisational innovations, and it is argued that lack of hindrance from existing infrastructure can be a competitive advantage for many developing countries.

Increasing population, education and wealth in developing countries have potentially major (and uncertain) implications for Australian rural industries. Increases are expected in demand for agricultural goods and services, including both meat and plant-based foods produced in Australia and other developed countries, as well as demand for leisure goods and services. Things won't be quite that straightforward, however. Demands for sustainably produced food, better quality food, and plant-based food are likely to increase in developed countries. Trade and diplomatic

OVERARCHING DRIVERS OF CHANGE

The following sections consider many potential drivers of future change in natural resource management. We think four of the most far-reaching are:

- changing numbers of people and where they live;
- changing levels of education and understanding of how ecosystems — managed and 'natural' — function;
- global connectedness which, whether it increases or decreases, has implications for movement of organisms, ideas, cultures, goods, money and people around the world;
- increasing impact by developing countries on global markets and cultures, as innovators and consumers.

Movements of people

The issues of immigration and refugees could have unexpected impacts on natural resource management. These issues are tipped by most futures analysts to become even more important in coming decades. Major uncertainties are where immigrants and refugees may come from, where they will live once in Australia (city versus country) and how they might become involved with natural resource management. The possibility of a shortage of skilled labour is feared and this could include skills in research and development and in natural resource management. On the other hand, skilled immigrants could contribute new insights and diversity to Australia's innovation system.

Movement of people to and from cities could go in a number of directions, all of which have implications for natural resource management. Whereas there is a general trend worldwide and in Australia of urbanisation (movement of people from the country to the cities), there are at least two major contrary trends.

The movement of people to the coast (so-called 'sea change') and the further development of the coastal culture are showing signs of continuing. In addition, advances in communication technologies are tipped to make high quality health, education and other services available in regional centres and encourage those who can afford it to work remotely from outside major cities. This is likely to cause increased focus on several issues already developing, including: demands on water and other infrastructure; sorting out of relationships between levels of government; and tensions between agriculture and urban development on what was once prime agricultural land. We will need to understand the impacts of peri-urban and regional development and to come up with imaginative solutions to the challenges.

Changes in rural lifestyles worldwide

'In the 21st century new demographic developments, unprecedented in history, face the fifty countries of the developed world. These trends may be summarised as 'fewer babies, longer lives, diverse households, older populations, living alone, more immigrants', all of which raise important theoretical issues and practical problems.' (Oxford Centre for Population Research)

'It appears that increasing numbers of farmers are choosing to continue to farm on grazing enterprises in the absence of a next generation interested in taking over the business. [Between 1996 and 2000] median farmer age continued to increase, a result not just of declining younger entry, but also of the new phenomena of delayed exit by older persons. Over two decades these trends have dramatically changed the age profile of the farmer population. Since 1976 the number of farmers aged in their 20s has declined by over 60%. ... Projections using the basic model suggest the ageing of the farm population will peak within 10 years, though this finding is based upon entry and exit behaviour remaining similar to that displayed in the past 15 years. The model projects a wide range of potential population decline scenarios, ranging between 10%– 50% over the next 30 years. There is significant regional variation in these projections, consistent with the conclusion that some parts of the agricultural landscape are on 'post-productivist' trajectory out of commercial agriculture.'

(Neil Barr (2004). The Micro-Dynamics of Change in Australian Agriculture 1976–2001. Commonwealth of Australia, Canberra)

relationships with Asia, including demand for environmental technologies, could be unstable and changing in the next few decades. Examples of major uncertainties include China's development trajectory and who it chooses to form alliances with, and what happens with South-Pacific nations and the demands on Australia for aid and/or peace-keeping.

Ageing Australia

Much has been made in recent times of the ageing of the Australian population. We deal with this in more detail on the CD-ROM. It will pose economic challenges. But little of the literature has focussed on potential benefits such as an opportunity for systematic revitalisation of society. This could include significant contributions to sustainable land management, for example through the use of retirement benefits to protect natural resources under tax or other incentive schemes.

LANDSCAPES

Some of the challenges remain the same

The National Land & Water Resources Audit recently identified the major environmental challenges for Australia now and in the short-term future. Have the major challenges changed over the past twenty years? Not much, although a few new ones have emerged and our understanding of the causes and significance of challenges like salinity has improved. Salinity, soil erosion and loss of habitat for native plants and animals are still major concerns arising from some land clearing and the introduction of pests and weeds. Awareness and concern have increased with respect to water availability and quality, climate variability and change, air quality, ozone depletion, energy consumption, waste production and disposal, soil acidity and the accumulation of nutrients and pollutants in ecosystems.

KEY POINTS

Likely trends

- increasing understanding of natural processes and awareness of environmental issues among decision makers;
- pressures from Australian and overseas populations and what they need to survive and thrive;
- continued decline in a range of slow (longer-term) ecological processes that maintain the natural environment.

Uncertainties

- the ability of ecosystems to recover;
- how our assumptions and attitudes towards ecosystem resilience, which underpin most landuse decisions and policies, change;
- the extent to which policies and management consider the interdependencies between humans and the natural environment from a systems perspective;
- the degree to which governments and other funders of environmental works focus on urgent institutional and infrastructural reforms;
- global connectedness and its implications for emergence and spread of pests and diseases and approaches to dealing with global environmental challenges.

Possible shocks and surprises

- major attitudinal swings;
- rapid decline in ecological systems that we didn't realise were near limits;
- unexpected interactions between social and ecological processes, across different scales of space and time, producing problems we are not ready for;
- rapid climate change;
- rapid evolutionary changes in microbes, viruses or insects;
- large scale geo-engineering projects that alter the climate on a global scale.

A lucky surprise

In his acceptance speech, Nobel Prize winner Paul Crutzen revealed how humans survived the 1970s by sheer luck. Talking about the choice between chlorine and bromine when making the first chloro-flouro-carbon refrigerants (CFCs), he pointed out that the choice of chlorine was made simply because the chemist involved was a chlorine chemist. Chlorine reacts with ozone only under certain conditions, but bromine is different:

'This makes bromine on an atom to atom basis almost a hundred times more dangerous for ozone than chlorine. This brings up the nightmarish thought that ...[if bromine had been chosen] ... we would have been faced with a catastrophic ozone hole everywhere and at all seasons during the 1970s, probably before the atmospheric chemists had developed the necessary knowledge to identify the problem and the appropriate techniques for the necessary critical measurements. Noting that nobody had given any thought to the atmospheric consequences of the release of Cl or Br before 1974, I can only conclude that mankind has been extremely lucky...'

We cannot always anticipate the precise impacts of our actions on the environment, but we can anticipate that surprises like this can and will occur. Futures thinking helps us consider where such surprises could come from. Even 'wild' ideas should not be discounted without a second thought.

We expect to see ongoing decline in a range of slow ecological processes that maintain ecosystems (including those maintaining water movements and quality in landscapes, the health and stability of soils and waterways, natural regulation of pests and diseases, protection from extremes of weather, diversity of genetic material, and cultural values of landscapes). The uncertainty that could bring good or bad news is the rate at which these declines will be slowed or reversed by wise environmental policies, technological innovation and improved management practices.

Uncertainty from poor understanding of interactions

What could cause the nature of these challenges to change in the longer term? There will be surprises as our understanding of ecosystems grows (see 'Ecological Surprises' box). But generally the biophysical challenges are likely to remain similar for some time. The links between ecological and social processes in the future, however, are much less certain.

Much of the uncertainty about future environmental challenges comes from our poor understanding of the ways in which changes in water, soil, biodiversity and climate might interact with one another and with social and economic systems. Mostly, these parts of our environment have been studied separately in the past.

For example, the current debate about water policy focuses on improving the efficiency of water use and developing markets for water trading. There is a loosely defined expectation that these measures will lead to a socially and ecologically sustainable outcome. Increased debate is likely about how much markets need a hand from policy makers and regulators. Market-based tools are powerful and difficult to control. They can get results quickly and lead to substantial changes in how and where water is used. But they also could take us where we would rather not be or are not ready for. Investment in research could consider the possible trajectories of water markets, their legal implications, how they might intersect with markets for other ecosystem services, and their broader social implications.

An old Azerbijani fable tells the story about two frogs that fell into a jug of cream. Unable to get out, one gave up and sank to the bottom. The other decided to do what he had always done in water — swim. So he paddled with all his might and, in the process, churned up the cream so much that it turned into butter and he crawled out. It is a fable with a comforting ending. Important questions for natural resource management in the future might be 'Are we in cream or water? How effective is our swimming? Is there another approach we could or should be taking?'

Other examples of where we need more understanding of system-wide impacts are:

- climate change (how could its potential impacts affect us socially and economically as well as environmentally?);
- emerging technologies (prime examples are our poor understanding of the potential landscape scale impacts of biotechnologies and the very limited research on environmental applications of other technologies like nanotechnology);
- soil degradation (for example, only recently have we seen research on the impact of soil acidification beyond farms and we have seen few examples exploring the potential of new biotechnologies to improve or restore soil health);
- interactions between environmental health and human well-being (especially for indigenous communities), and;
- consequences of expected declines in volunteerism for achieving natural resource management goals.

The future of volunteerism

Volunteers have made major contributions to natural resource management in the past. What might be their roles in the future? What factors could see rates of volunteerism increase or decrease in the future? What might be the consequences? How might institutional arrangements adjust to make the most of future opportunities and avoid undesirable outcomes?

Ecological surprises of the 20th century

Researchers at the University of Wisconsin, Madison USA identified the following facts that seem so obvious now but that came as surprises when they were first discovered*:

- toxins are concentrated as they move up food chains leading to people;
- ecosystem modifications often make it more likely for diseases to emerge;
- removing the animals at the top of food chains increases the vulnerability of ecosystems to excessive build up of nutrients and outbreaks of unwanted species;
- pests and pathogens can rapidly evolve resistance to biocides;
- desert expansion is promoted by changes in land use.

*Bennett, E.M., SR Carpenter, GD Peterson, GS Cumming, M Zurek, and P Pingali (2003). Why global scenarios need ecology Front Ecol Environ 1(6): 322–329

New understanding of environmental surprises and shocks

The way we think about environmental threats is changing. There has been growing recognition of the importance of considering multiple scales of time and space and the environmental and social processes that operate over these different scales. This has led to thinking about thresholds, or tipping points, in ecological and social systems that, once reached, could see rapid and uncontrollable change.

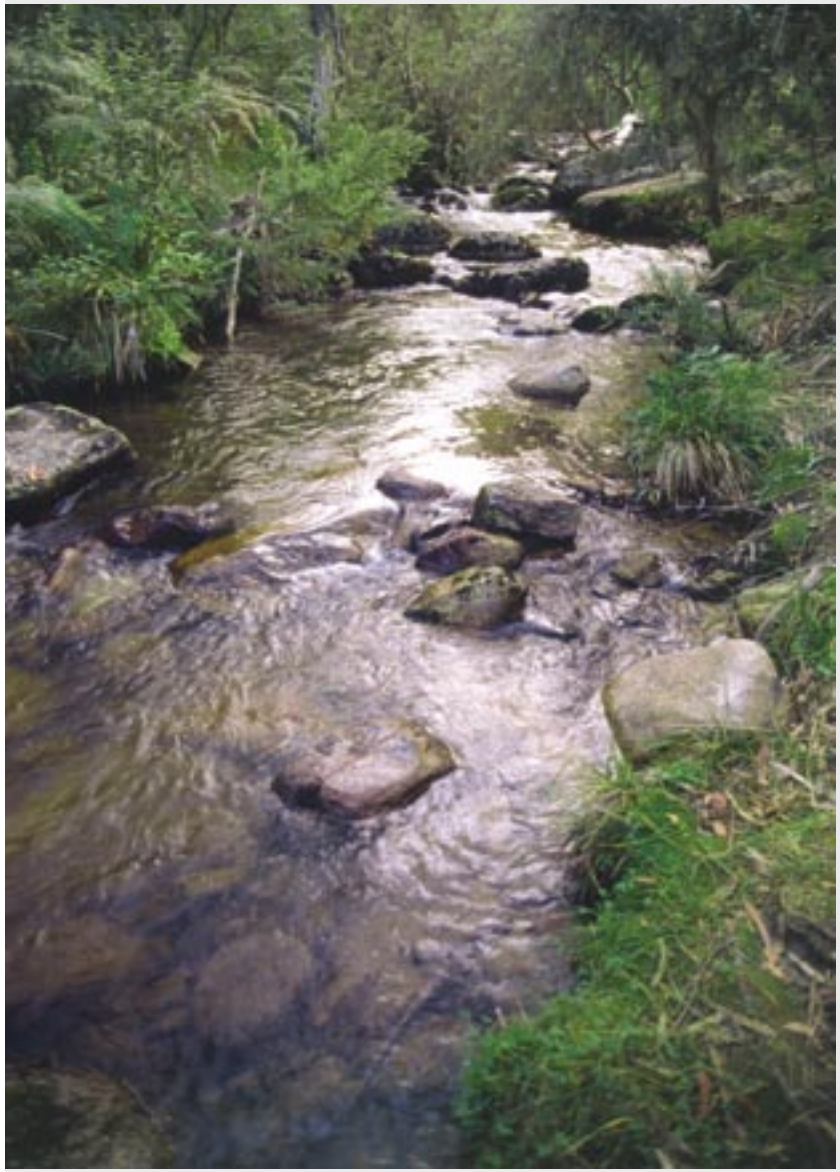
A recent example is the unlikely but still plausible possibility of a rapid change in global climate. Others that are happening already are flips in the state of waterways, that see them go from clean to polluted very quickly and to suffer imbalances in species leading to phenomena like algal blooms and fish kills.

Most policy and management decisions about natural resources make conscious or unconscious assumptions about how well ecological and social systems can cope with pressure and change, often called their 'resilience' (see 'Resilience' box). Yet very little research and development is occurring in this area.

Another source of tipping points is the convergence of technologies that have not previously come together. Combined with increasingly rapid changes in technological capacity, the ingredients are there for rapid and unpredictable impacts for ecological and social systems.

Surprises also come from interactions between processes occurring at local scales to produce major problems at larger scales. Examples include:

- environmental consequences of conflict and refugees;
- local river management (eg. dams, levees) affecting basin-scale flood risk and disease risk (eg. schistosomiasis, malaria);
- land cover changes interacting with climate feedbacks to help cause desertification;
- over-fishing increasing the susceptibility of fresh and coastal waters to harmful algal blooms;
- contagious phenomena like invasions by foreign species and the emergence of diseases from humans living close to nature or domestic animals, or domestic animals and plants exchanging diseases with wild species.



Resilience of ecosystems and communities

In the past, the response to environmental problems has often been to exert greater control over the system in question. In many cases, this has led to short-term improvements in some aspects of the system but, in the longer term, new problems often arise and ongoing control becomes expensive or fails completely. The "command-and-control" approach aims to get a system into some particular optimal state for a few key outcomes. It tends to overlook interactions between different parts of systems. It assumes that change will be incremental and linear, and focuses on average conditions rather than extreme events.

Unfortunately, the real world doesn't operate this way. Regions, and the enterprises they support, are feedback-dominated, interlinked systems of people and nature. They are complex systems in which changes are non-linear, often lurching, and there's no such thing as a sustainable 'optimal' state. Controlling one or a few variables to sustain an 'optimal outcome' inevitably leads to unintended and frequently perverse outcomes.

There is a growing school of thought, led by some of the world's top ecologists, that the key to defining and building sustainability is not about optimisation but about resilience. 'Resilience' is the capacity of a system to absorb disturbance, undergo change and still retain essentially the same function, structure and identity.

In stark contrast to the command-and-control paradigm, resilience thinking is an adaptive approach to environmental uncertainty and social and economic disturbances. It is based on understanding and managing the resilience of a system. The real threats in almost all regions in which natural resources are under threat are declines in resilience of their ecological and social systems. Changes in resilience underlie the increasing vulnerability to external shocks, and are manifest in increasing social, economic and ecological costs.

Further reading <http://www.resalliance.org/>

LIFESTYLES

Australian identity, vision and attitudes

Australia currently is wrestling with its role in its region and the world and with how it defines and implements sustainability. The concept of sustainability is well established in policy but is poorly understood by the majority of Australians. Futures studies have contemplated a range of ways in which Australia's vision of itself could become clearer. This could happen in the face of major conflicts and external threats, but Australians are more likely to change their views of themselves slowly, according social commentators Bernard Salt and Hugh Mackay whose work we draw on in the CD-ROM document.

Achieving sustainability could require reform to institutions, governance, policy, legislation, funding and political will. To play an effective role in these processes scientific organisations will need to communicate with a wider, and possibly less science-focussed, audience. Various social commentators have reported on what they think is an increase in people searching for other ways than science to explain the world and find their place in it.

Differences in attitude, beliefs and lifestyle between past and future generations have major implications for natural resource management. In Australia and worldwide, coming generations are better educated and understand enough about environmental issues to know they are more complex than is often portrayed by interest groups. They are expected to be impatient for action and to demand that research and development is policy-relevant.

KEY POINTS

Likely trends

- ageing of the Australian population (which could be a problem or an opportunity);
- ongoing urbanisation, including movement of young people from rural communities and amalgamation of rural enterprises;
- ongoing differences in attitudes towards Australia's place in the world
- continued changes in attitudes in Australia and other western countries leading to greater individualism, reduced trust in authority, lowered hope for a better world, reduced participation in common-good causes, a rise in ideological versus technocratic thinking, and declining belief in economic prosperity as a measure of human well-being;
- generational change in attitudes to work and careers.

Uncertainties

- how fast or far the above changes will go and whether they will start to reverse in coming decades;
- the degree of connectedness between Australia and other countries, and global developments with respect to social equality or social unrest.

Possible shocks and surprises

- increasing insularity of nations;
- loss of confidence in our political system leading to major structural change;
- major changes in Australia's view of its role in the world due to conflicts and terrorism;
- collapse in the environment movement due to rising distrust of authority and lack of apparent disasters;
- slowly accumulating changes in public opinion lead to a sudden emergence of a widely accepted philosophy towards harmonising conservation and development ethics.

There is likely to be decreased faith in government to protect the environment, but a declining willingness to take action as a community. Agencies could be increasingly pressured by younger staff to get moving on environmental policies and actions. The expected increase in use of powerful market-based instruments could heighten both the benefits and risks of these actions. Consequently, it will be increasingly important to watch and learn in sophisticated ways.

There could be challenges for setting up reliable, highly experienced teams to address long-term problems. These challenges are likely to arise from: the anticipated trends of more causal and short-term employment; more frequent changing of jobs and skills; less employee loyalty or aspiration for long-term stable employment; and an ongoing brain-drain if support of research and development by Australian-based businesses does not improve.

East meets West

In Australia we are becoming more aware of the different approaches to the environment taken by indigenous Australians compared with later settlers. Many see hope for the future in convergence between these perspectives. Eastern and western cultures differ in similar ways and many trend analysts suggest the future will see greater convergence between these cultures.

Eastern cultures emphasise many aspects of the environment that lie outside traditional western science. The concept of Chi (good and bad energies) is applied to thinking about cities and natural ecosystems. Chhewang Rinzin speculates about the different roles of spiritual thinking in his adopted Bhutan compared with the Netherlands, where he trained. In Bhutan, harmony with nature is sought through beliefs (mostly Buddhist) about the sanctity of all life and the spiritual values of nature. Rinzin suggests that many Christian and Islamic nations have separated natural resource management from spiritual beliefs and that people are much less comfortable talking about spiritual aspects of their relationship with nature than scientific and economic aspects.

Spiritual and other beliefs that might be considered 'non-scientific' or at the fringes of traditional science also affect consumer preferences in the East. For example, some Chinese woollen mills had striven to

produce garments that are anti-static and resistant to electromagnetic radiation, thus minimising 'bad vibes' and maximising the healthiness of garments. The possibility of Australia producing fibre and other environmental products that promote natural health is a potential commercial opportunity for the future.

Sources:

Chhewang Rinzin's essay at <www.rim.edu.bt/rigphel/rigphel1/sustainable.htm>

Wuxi Mill at <http://www.wxyimao.com/jianjie-e.htm>

Thinking by Ian Ferguson & Associates <http://imaginativefutures.com>

Exploring dilemmas for sustainability

The trend away from science-centred decision making troubles many in the science community. How can we better understand the challenges?

As a consultancy to Land & Water Australia, Richard Hames, Bronwynne Jones and members of the Hames Group developed a set of scenarios based on two major dilemmas detected in interviews with a range of practitioners in natural resource policy, research and management. The two dilemmas were:

- Science-Way-of-Knowing versus All-Ways-of-Knowing. The dilemma is whether we focus primarily on science to understand the relationships between humans and the natural world or guide our understanding and decision making using a broader set of philosophies and beliefs. Some believe that we can define sustainability in scientific terms and that research results should be our main guide toward sustainability. But many in society have little scientific background and interpret the relationships between humans and nature in a range of philosophical ways. Take for example debates about management of wild populations of native animals like kangaroos and koalas. From a scientific point of view culling can be logical, but that is anathema to some other sectors of society.
- Whole Systems versus Parts of Systems. We know that moving towards sustainability requires us to understand the workings of whole social-ecological systems, and that interventions in parts of systems have often made matters worse (eg. incentives for farming practices that have resulted in increased land degradation). On the other hand, as policy makers or researchers, we usually break problems into pieces and deal with manageable bits, and this is reflected in the compartmentalised structures of agencies.

These dilemmas were used to construct four scenario spaces that define different ways of looking at the world (see 'Dilemmas for Sustainability' box). Scenarios have been written from the points of view of each of the four quadrants, imagining how hypothetical worlds might look if everyone had the same point of view. Of course, people in the real future world will have mixtures of these views, but the scenarios help us see the benefits and pitfalls of different ways of thinking about sustainability.

For example, the intent of policies for sustainable development probably lies in the 'Country' quadrant, while their implementation lies in 'My Backyard' or 'Hothouse'. Environmental and industry lobby groups often operate in 'My Backyard', while scientific researchers are operating in 'Hothouse' and 'Botanic Garden' This poses challenges for communication between the different sectors that will require better understanding of one another's beliefs and motivations. It might also require research and development agencies to rethink some of their strategies and practices, especially with respect to adoption of knowledge (see page 20).

National and international governance

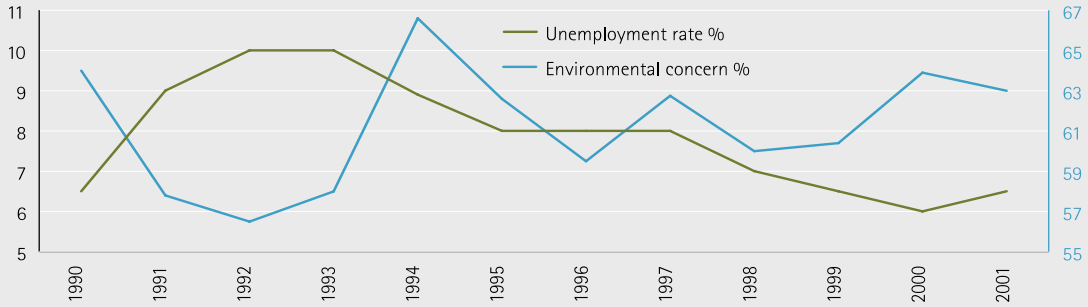
In general, international governance regimes are weak and poorly developed although exceptions are beginning to emerge (eg. in the European Union). International environmental law, treaties, and the like are vague. There is little agreement on minimal requirements. There are few workable enforcement mechanisms, and few funds. The influence of international environmental institutions like the United Nations Environment Program is low compared with trade institutions like the World Trade Organisation (WTO).

There is currently a push for a World Environmental Organisation (WEO) that could focus on removing impediments to bargaining (and trade) with respect to the global environment. Will it get traction? This will depend on how larger and more powerful nations than Australia react. A challenge will be avoiding conflict between trade regimes and environmental regimes. In the longer term,

several options are available to Australia, including: do nothing; refine the status quo governance structure; instigate regional environmental organisations; play a key role in developing a new global environmental organisation; or work to develop new governance approaches through different global mechanisms. This is fertile ground for serious futures analysis.

Domestically, there has been limited public dialogue about what might follow the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality. Market-based mechanisms are under trial and the dialogue around them includes some thinking about new institutional arrangements. But research and imagination are needed beyond these confines. While there has been a trend towards devolution of responsibility for decision making about the environment, it has taken some time for real authority to be devolved in most states and the durability of this trend remains to be seen.

Tensions between environment and economy



Unemployment rate vs environmental concern suggests that voters trade-off the environment against jobs (Source: Newspoll, cited in 'Aspire Australia 2025', Business Council of Australia <www.bca.com.au>).

While the environment is seen as a mutually exclusive alternative to people's economic well-being there is potential for instability in attention to natural resource management. In the past, voter concern about the environment has risen and fallen from year to year, being low when unemployment is high (above). The importance of the environment in the policies of all political parties also has fluctuated from term to term, depending on what other issues were on their agenda (see the Business Council of Australia background analyses at www.bca.com.au).

How might perceived or real tradeoffs between the environment and economic factors play out under futures in which the role, power and credibility of governments and the media change and the sophistication of measuring and responding to voter expectations increases?

DILEMMAS FOR SUSTAINABILITY

Four different ways of thinking depending on (1) a person's or an organisation's focus on whole systems versus parts of systems and (2) their focus on science or on a broader range of ways of understanding the relationships between humans and the environment.

	Parts of systems	Whole systems
All ways of knowing	My Backyard: Focus on specific issues for emotional or philosophical reasons (eg. lobby groups, local or specific interest groups, everyone falls into this quadrant on some issues)	'Country': Thinking about whole systems from a range of philosophical viewpoints (eg. Gaian philosophies, the perception of sustainability in the minds of many non-scientists)
Science way of knowing	Hothouse: Focus on the most important individual issues from a scientific point of view (eg. scientific research organisations have most of their activity here for practical and career reasons)	Botanic Garden: Thinking about whole systems from a scientific perspective (eg. multi-disciplinary, ecosystem scale scientific research)

Futures studies have identified a number of paths that could see the environment rise or fall in political and policy agendas. For environmental issues to get onto agendas in the first place in Australia they have to have major immediate impacts and be understandable to the public. Complex issues that are hard to explain in sound-bites tend to be overlooked until they reach an obvious crisis. The environmental agenda has been driven largely by environmental scientists, international agencies, and non-government organisations — all of which are suffering and may suffer further in the future from growing suspicion of authority and declining participation by the public in common good causes.

On the other hand, several factors could see greater attention to the environment. For example: increasing environmental awareness and knowledge among young Australians and growing demand for the difficult questions about human-environment interrelationships to be addressed; emerging evidence of links between ecosystem function and human well-being; and improved mechanisms for bringing the environment into economic transactions. A challenge for science is to produce highly credible evidence for the importance of good environmental management in national and regional economies.

LIVELIHOODS

Globalisation, economic and business challenges

Globalisation is often listed in futures studies as a relative certainty. Recent events, however, open the possibility of a less open and connected world in many respects and this creates some major uncertainties. Scenarios like those of the Millennium Assessment (<www.millenniumassessment.org>) explore the consequences of increasing or decreasing connectedness.

A globally connected world with open trade and free movement across borders would bring many benefits, especially in terms of equity, if supported by the right policies and safeguards. Global cooperation has shown itself to be effective in controlling outbreaks of disease in the case of SARS, but increasing global movement of people was in part the reason for the disease spreading so quickly. A sign of growing connectedness in business is the move from the competitive and compartmentalised business world of 'New Public Management' through 'Joined-up Government' or 'Integrated Governance' to 'Network Governance' to deal with the increasingly complex policy challenges facing governments.

Movements of people in an increasingly connected world could encourage the spread of pests and diseases of humans, livestock and plants. The increasing exposure of people in developing countries to ecosystems previously isolated from humans, together with increasingly close cohabitation with stock and captive wild animals, dramatically increase the risks of new diseases emerging.

KEY POINTS

Likely trends

- high rates of development of new technologies, including convergence between previously separate technologies, with increasing power to influence landscape-scale ecological processes, leading to potentially bewildering choices for natural resource planners and managers;
- new ways of trading and exchange;
- international trend towards increased voluntary public reporting and mandatory disclosure in some cases;
- increased prices for oil and gas.

Uncertainties

- whether or not the perceived clash between conservation and economic growth is resolved;
- our ability to move away from institutional arrangements in which issues and jurisdictions are compartmentalised;
- whether government retains the prime role in natural resource management or we see greater roles for non-government organisations, covering a greater diversity of issues and views;
- the ways in which globalisation plays out and its impacts on trade and other alliances between Australia and other countries;
- the impact (potentially great) on global markets by developing countries, as innovators and consumers;
- whether or not hoped-for technological advances eventuate and meet expectations;
- whether Australia can adapt fast enough to stay competitive in an information technology revolution;
- the chance of a politically, economically and socially unstable Asia-Pacific region for several decades, demanding attention and resources from Australian governments.

Potential shocks or surprises

- Australia not keeping pace with the information technology revolution;
- major rapid changes in Asian markets (eg. China switching its trade focus to eastern Europe);
- the centre of the world economy moves to South Asia;
- introduction of new diseases as a result of increased movements of people and animals;
- major terrorist attack on Australian soil with impacts for decades.

'Much of the environmental change that will occur over the next 30 years has already been set in motion by past and current actions and many of the effects of environmentally relevant policies put into place over the next 30 years will not be apparent until long afterwards.'

(United Nations Environment Program, 2002. Global Environment Outlook 3: Past, Present and Future perspectives).

The poor condition of much of Australia's environmental infrastructure is of major concern in its own right but even more so in combination with plausible future social and political changes. The amount already invested in old technologies in most sectors of the Australian economy could make it hard to change in a time when technological innovation becomes more and more rapid.

More speculatively, a new approach to capitalism may emerge. At the extreme, some commentators are suggesting that a long period of reliance on technical knowledge in decision making, one manifestation of which was economic rationalism, is ending. Two major drivers are loss of confidence in science as a way to solve humanity's problems and emerging evidence that economic growth does not lead automatically to increased human well-being.

Increasing sophistication will be needed in risk assessment and risk management approaches, whether globalisation increases or decreases. If globalisation decreased it probably would be due to tensions and unrest that led to stronger protection of individual national interests. In this case, the risks of eco-terrorism and eco-crime (eg. smuggling of valuable species and other resources across borders) would be high. Eco-terrorism and eco-crime also are high concerns in a globalised world, and we need to consider the risk-multiplier effect from globalisation caused by bringing formerly unrelated global-sized sectors together. These risks need to be considered together with increased risks and opportunities from the convergence of technologies, which are set to dominate innovation in the next decades.

Rural and regional land management

Despite persistent calls for a revolution in landuse in Australia, few visions or scenarios for that revolution have been advanced. Discussions about the future talk about new products from land management enterprises and new technologies that might revolutionise how farms are managed. They talk about the massive impacts on rural communities of climate and demographic change. They talk about the consequences of continuing with current patterns of consumption. But, apart from some emerging ideas about the use of market-based mechanisms and greater commercial use of native species such as kangaroos and bush-plant products, very few really different ideas about how Australia's land might be used have come forward.

This is probably because we find it hard to imagine social or economic systems changing dramatically from where they are today. However, if current value sets and consumption patterns truly are unsustainable, as many analysts conclude, then major change is inevitable.

Several challenges may emerge to Australian agriculture's ability to maintain its international competitiveness. Some commentators suggest that Australian agricultural systems are approaching limits to productivity increases because of soil degradation, water availability, limits to what technology can do to compensate, and lack of new land for development. On the other hand, the gap between the best and average performers in each sector tends to be large, suggesting that substantial increases in overall productivity are possible even with current knowledge.

In the future, various factors (exchange rate realignments, changing patterns of world investment and demographic pressures) are set to demand higher levels of productivity. Some commentators argue that the pressures for international competitiveness, coupled with little or no increase in real prices of commodity exports, may intensify economic pressures on the environment to achieve productivity gains.

Already the focus on northern Australia as a source of water and undeveloped land is increasing. Dialogue about agricultural land uses and ecotourism in particular will increase in coming decades. The lessons learned in other parts of Australia should be an important resource for planners and managers.

There are hopes and fears for rural communities. Bernard Salt argues that Australia has moved from a bush culture in 19th century, through a suburban culture in 20th century, and is moving into a coastal culture in the 21st century. Most commentators agree, however, that the bush culture will remain an important part of the Australia psyche for some time. What will the future of rural and regional Australia look like? Movement of young people to cities and towns and amalgamation of farm enterprises seem inevitable in many rural regions for at least a decade into the future and probably longer (see 'Changes in Rural Lifestyles' box on page 10).

On the other hand, improving communication technology and the desire of younger Australians for a better quality of life could see more people settling in regional centres and commuting virtually to the rest of the world. One other possibility is increased settlement of immigrants and refugees in rural areas (already being encouraged by the Australian Government). This raises issues of cultural differences in approaches to land management and the environment in both positive and negative ways.

Research and imagination are vital to produce new ideas for governance and institutions, so that regional Australia can benefit from change by being pro-active. While it seems highly unlikely that the two-party system of government in Australia would change, there are major plausible changes to levels of government and structures for regional governance. Reduction of the number of levels of government and swings towards or away from central government are some possibilities for the next few decades explored in the 'Aspire Australia 2025' scenarios of the Business Council of Australia (<www.bca.com.au>).

Coping with rapidly changing technologies and, potentially, volatile market opportunities, is likely to be a feature of the next few decades. The resilience of social-ecological systems emerges as an underpinning issue in many of the global and Australian futures studies. It is conceptually at the heart of many current initiatives to build capacity for change in rural Australia. Many of the scenarios envisage dire consequences for Australia if desirable resilience is low over coming decades (or indeed if undesirable resilience is high causing resistance to change), and yet we struggle to measure resilience.

The research and development underpinning land management also needs attention. The value of modelling in landscape scale research is well established, but Land & Water Australia's Redesigning Agriculture for Australian Landscapes (RAAL) Program suggests that careful learning about how native and agricultural systems function will continue to yield valuable insights and innovations (see the Land & Water Australia website www.lwa.gov.au for further reading on RAAL).

The possibility of rapid changes that impact on the Australian economy and lifestyles is significant. Most of what has been discussed above concerns slow and steady change. A shock event that may become more likely is a major terrorist attack on Australian soil. Estimates suggest that something like the 2004 Madrid bombings could have a major medium-term impact on the Australian economy and would certainly distract attention and funding from natural resource management and reduce confidence in production. Other shocks that could distract attention from natural resource management reforms include political, economic or environmental turmoil in the Asia-Pacific, a major disruption to global energy supplies, and preoccupation of Australian governments with the ageing population challenge.

Public and private organisations may need to take greater risks and be more flexible in coming decades. The likely instability in global power and trade alliances and opening and closing windows of market opportunity will favour organisations that are able to operate closer to the margins of risk, and that are flexible enough to exploit new opportunities quickly. This could be a challenge for public organisations and opens the possibility for new and imaginative government-non-government cooperation and partnerships.

Technology and future farms

In the coming decades, global agriculture could find itself in a great transition. Some commentators suggest that food and fibre could be grown increasingly indoors in tissue culture in giant bacteria baths, at a fraction of the price of growing staples on the land. Others think such possibilities are over-rated but can see great opportunity in improvements to animal and plant products already in production. Already, we see the emergence of computerised technologies that will more and more be used to monitor and manage individual animals or planted areas for multiple traits. Many farms of the future will be based on precision agriculture, guided by computerised information on all aspects of the environment and the markets being accessed. Farms of the future hopefully will have learned from improved understanding of how native plants and animals are adapted for the Australian environment. But there may be limits to the extent of straight 'bio-mimicry' because there will always be differences in objectives between native and agricultural systems.

The efficiencies that might emerge from information technology, biotechnology and nanotechnology are partly uncertain and partly already visible. So much has been written about the promise of biotechnology and nanotechnology that it has become accepted as

inevitable that these benefits will arise. Very few strategic plans consider what might happen if these benefits fail to eventuate. Concerns are emerging already that biotechnology is not delivering what has been expected of it. On the other hand, what if these technologies go ahead faster than expected? Will industries and markets be able to cope? What could the impacts be on Australia's unique plants and animals? How can we get ourselves ready to make the most of the opportunities?

The future trajectory of crop yields in Australia will depend heavily on the continued maintenance of disease resistance, development of innovations in breeding and crop management, and the choice of regions cropped. Some of the greatest potential is in the production of industrial chemicals and pharmaceuticals from crop and animal products and new technologies to modify physical, chemical and biological systems in new ways at faster rates over larger spatial areas.

New sciences that allow us to understand how we think may have major implications for natural resource management. Although much is written about biotechnology and nanotechnology, major progress is also occurring in social sciences like cognitive neurosciences. Many argue that the biggest challenge to achieving sustainable land management is to understand how people form attitudes and make decisions and to communicate knowledge in ways that enable the majority of people to make well informed decisions about their and society's futures.

Factors affecting regional communities

Likely trends

- ageing rural populations;
- amalgamation of farms;
- increasing search for more sustainable technologies and more stable overseas markets;
- innovation to find new products and practices for rural lands that are more in tune with Australian conditions;
- subdivision of more land around cities and regional centres.

Uncertainties

- whether effective policies for managing subdivision of land around regional centres are achieved;
- the extent to which inadequate agricultural research, training, and credit continue to limit the capacity of farmers to adapt to ecosystem change;
- the degree to which Australian land use is regulated;
- the extent of local control of food production, distribution and retail;
- the validity of the assumption that agriculture as a managed human system is adaptable to the challenges of the future we now face;
- the ability to meet demand for traded agricultural goods, which could increase by several orders of magnitude;
- how the continuing prospect for detrimental landscape changes will challenge agricultural technology and productivity;
- whether farms will move towards further specialisation, concentration and uniformity [industrialised agriculture] or diversify.

Possible shocks and surprises

- agrifood system dramatically shrinks;
- the global agrifood system does not need Australia, except to feed the local population;
- global change alters agricultural zones beyond the ability of world production to adapt;
- either rapid failure to adapt to changing demands for water, or rapid adaptation making water far more available than it currently is;
- changes in the demand for water resources;
- political unrest in our region disrupts confidence in our agricultural production.

Intellectual property and innovation

Two areas that are likely to have large and unpredictable impacts on natural resource management in Australia are intellectual property (IP) and innovation.

Acquiring and protecting key knowledge will become increasingly costly, and intellectual property is a potential source of international conflict in the future that could lead Australia to make hard decisions about who it forms alliances with. The effectiveness of the USA in gathering market intelligence and securing ownership of IP has been unrivalled. It comes partly from the ability of the USA to speak as one voice. There is much discussion among Asian, European and South American nations about how they might form alliances to rival the USA's voice, but so far cultural differences and history have slowed progress.

The ground rules covering the use and processing of resources and of technology in natural resource management may change — we may see increased complexity in the regulatory environment, more litigation, and more avoidance/circumvention behaviours. Some of these ground rules will be set by dominant global players. If these players continue to demand different requirements and obligations we may well have to choose sides where in the past we have been able to balance our interests with respect to competing approaches. Countries may try to restrict access to intellectual property and technologies for reasons of security and comparative advantage.

Australia is likely to face major international competition with respect to innovation. Increasingly innovation is likely to come from developing countries unencumbered by existing technologies and infrastructure. As their confidence grows, they may challenge standards set by the developed countries (witness China's recent decision to follow its own standards for mobile phones). As their people become more affluent their consumer power is likely to influence more and more what markets produce. Australian Government expenditure on R&D is high in international terms, but business investment in R&D is low and this is where we could fall further behind other countries. The shifting emphasis from investment in basic science to spending on new technical applications of existing science may continue or reverse. Future innovations are likely to arise from the integration of existing technology in new ways and through new applications of existing science, in addition to new breakthroughs in basic understanding.

While Australia has areas of technical advantage, there are concerns about: the rate of adoption of technology; equity of access to technology; and public attitudes towards specific technology.

Courage will be needed among investors in innovation as there are likely to be uncertain times ahead. The rate of change in technological capacity is unprecedented. There is talk about change so fast that social adaptation cannot keep up (see 'Singularity' box on page 36). Some argue that surprises about what technology can do will be more and more common. Others argue that there is more predictability in technological change than we suppose. The most threatening analysis is that while technological capacity increases, the ability of humans to make wise decisions is stable or declining.

A SNAPSHOT OF POSSIBLE FUTURE CHANGE

Major areas of plausible change up to 2025

Type of change	Trends	Tensions
Environmental Governance:		
Strength of domestic environmental governance	↑↓	Strengthening most likely but some scenarios could see a decline
Strength of international environmental governance	↑↓	Either strengthening or weakening plausible under different scenarios
Market-based mechanisms	↑	Increase most likely – uncertain how much focus on additional solutions
Incentives/regulation	↑↓	Could see more or less regulation under different scenarios
Determination for action	↑↓	Generation X hungry for action, but complacency a danger. Later generations seem less determined
Environment on political agendas	↑↓	Environment increasingly important but regional unrest could distract
Technologies:		
Individual traits management	↑	Monitoring and selection of individual plants and animals
Biotechnology	↑	Increased focus but uncertain what aspects will be accepted
Nanotechnology	↑	Already emerging but misunderstood – high potential
Cognitive Neuroscience	↑	Application to understanding people's needs and decisions
Technological capacity/ wisdom of use	↑/↓	It has been argued that the former is increasing but the latter is declining
Surprises	↑	Trends over fifty years suggest surprises will be more and more frequent
Environment:		
Environmental quality	↓	Measures currently declining likely to continue, but how much?
Diseases	↑↓	Increased chance of emerging diseases if the world gets more connected, but better control through cooperative action
Climate Change	↑	Increasing problem – small risk of sudden change with big implications
Potential for mistakes	↑	Risks increase with rapid technological change, unstable governments, climate change, increasing globalisation, decreasing hope and participation, and impatience of coming generations

Type of change	Trends	Tensions
Economic change:		
Dematerialisation of industry (reduced consumption)	↑	Very likely to occur, but there is uncertainty about how quickly
Consumption	↑	Despite efforts to reduce, rising populations will cause increase in most scenarios
Cost of maintaining regional order	↑	Likely to increase as climate change and economic pressures impact
Costs of ageing population	↑↓	Ageing could be either a burden or an opportunity
Migration	↑↓	Connections between countries and movement of people and goods is likely to increase but some scenarios envisage a divided and inward-looking world
International Trade	↑↓	As above
Social change:		
Length of stay in a job	↓	Future generations expected to change jobs more often and casual work is expected to increase
Environmental consciousness	↑↓	Expected to be higher in the next generation but the extent to which it will translate to action is not clear
Specialisation	↓	People expected to be more generalists than specialists
Brain drain	↑↓	Intense international competition for mobile, educated people
Ideological decision making	↑	Some commentators suggest there will be a decreasing reliance on science and greater emphasis on belief at all levels
Hope for a better world	↓	Evidence that people are accepting that they cannot change the world for the better
Participation in common good causes	↓	Declining optimism is leading to less participation, support and volunteerism according to some commentators
Issue-motivated groups	↑	Emergence of more single-issue motivated groups with conflicting interests
Expectations/ role of government	↑/↓	People expected to demand more from what government does but to trust it with fewer important functions
Shift to coastal culture	↑	Change to simpler and more creative lifestyles and communities

SCENARIOS FOR AUSTRALIA'S FUTURE

Previous scenario planning projects

Since 1995, only a few major scenario planning projects have considered environmental issues along with social and economic ones at global or Australian scales. We review many of these on the CD-ROM. In the majority of scenario planning projects worldwide, the environment gets very little attention.

The scenarios revised on the CD-ROM discuss a range of issues of importance to Australia, that could impact directly or indirectly on natural resource management. The trends and drivers discussed throughout this document have been informed by these previous scenarios.

Issues addressed include:

- economic and political constraints to global competitiveness;
- structural reforms, constitutional reform;
- market forces, growth strategies;
- immigration;
- nationalism and isolationism, political philosophies;
- partnerships with Asia and the future of the Asia-Pacific region;
- globalisation and global governance;
- challenges of a globally wired world;
- product life-cycles and certification;
- implications for trade in agricultural commodities;
- changing attitudes and the social dimensions of change in Australia.

KEY POINTS

- Since 1995 several major scenario planning projects have considered Australia's possible futures
- Few have considered natural resource management in anything other than a peripheral way
- Even fewer have placed natural resource management at the heart of our futures
- There has been remarkably little highly imaginative thinking about the future management of Australia's natural resources — perhaps the old ways will do for some time to come, or perhaps it is just hard to imagine the linked environmental, social and technological possibilities
- We can make our future or we can accept what unfolds
- In this section we attempt some 'out of the box' interpretations of the trends and drivers discussed

Recombination of trends is the major source of 'out of the box' thinking in futures analysis.

Five examples of out of the box recombinations of trends and drivers

Futurist Kate Delaney explores some plausible and challenging scenarios she has drawn from trends discussed in this document.

1. The Big Shift

The agrifood sector continues to serendipitously adapt. There is a 'concern collapse' about the environment. The shift to the coastal regions expands. A single extended 'suburb' stretches across the entire southern and eastern coastlines. Coastal ecosystems come under intense pressure.

2. Home on the range

Population growth trends continue. Attitudinal change takes hold. The agrifood sector focuses on convenience food. Australia becomes semi-nomadic. A large part of the population may be permanently touring the country.

3. History Lost

Research and funding in science veer towards delivering new applications based on what becomes possible rather than what is needed. The agrifood sector declines. Many of our fears about environmental and rural decline eventuate. Rural Australia depopulates. Science loses its dominance and basic research stagnates. Data are lost as well as lessons from the past.

4. The Chameleon

Rapid technological change, regulatory change and ecosystem changes. Australians realise the perils of assuming that technology and human ingenuity can adapt to all environmental change. There is a global quest for knowledge, which leads to a rethinking of the relationship between humans and natural and built systems.

5. Agricolae Automata

Technology provides solutions. Regional centres grow as small-scale 'life sciences' [agrifood-health] companies flourish. Rural Australia becomes healthy and prosperous. This is a world of fully automated agricultural industry and distribution, enabled by the new Internet, electronic tagging, biotechnology, nano-technology, cognitive neuroscience and hydroponics in urban areas.

Some of the possible shocks considered include

- decline of democracy;
- rejection of minority groups;
- rise of an angry underclass;
- a constitutional crisis;
- a balance of payments crisis;
- conflicts between social movements;
- military conquest of Australia;
- total control of the Australian economy by transnationals;
- increasing control of public opinion by the media;
- regional food shortage demanding more food from Australia;
- collapse of food production capacity of Australian agriculture;
- regional or domestic natural disasters (eg. major centres struck by weather events, chemical spills, pollution events);
- uncontrolled mass influx of immigrants/ refugees;
- increased frequency and/or extent of droughts;
- major permanent changes in climate;
- collapse in world commodity prices and trade arrangements;
- rapid rise in oil prices;
- epidemics of new or old diseases affecting humans, livestock, crops, or native plants or animals.

Out of the box thinking in scenario planning

Scenario planners often use the failures of numerical forecasts to show why scenarios are a better tool for thinking about the future. But scenarios can also fail not so much because what they describe does not happen — which is a normal risk in scenario planning — but because things do happen that were not described in the stories although they might have been anticipated through deep understanding of existing information.

We can probably anticipate both unexpected discrete events, such as oil shocks, revolutions, major natural catastrophes and discontinuities in long-term trends. But how and when these events might come about and how they find their way onto political and policy-making agendas is much more complex and requires imagination and experience as much as empirical data and statistical analyses.

'The most important failure was one of imagination.'

(US Independent Commission into the September 11 terror attacks)

Scenarios must challenge our beliefs; scenarios that confirm conventional wisdom are of little use. However, the danger is that scenarios can sometimes be dismissed as being 'off the wall'. A balance must be struck between 'stretch' and 'fiction'. In many cases scenarios look to the extremes to gain insights about the future possibilities in between.

Recombination of trends is the major source of 'out of the box' thinking in futures analysis. This is what children do so effectively because they don't know that some things don't usually go with others. Inventors like Thomas Edison used a technique of recombining attributes of things he saw around him to invent new things. The skidoo is a good recent example of putting attributes of a motor bike together with attributes of skis — yet people were riding bikes and skiing for a long time before anyone thought of combining the two.

On these pages, we imagine some unusual combinations of trends and drivers that could lead to unexpected futures for Australia. Mostly they seem unlikely, but we should heed the words of the recent report on the September 11 attacks in the USA, which said 'The most important failure was one of imagination'.

How you could develop and use scenarios?

There is nothing stopping anyone interested in natural resource management from developing their own scenarios, based on the events, trends and drivers we have outlined or on ones they develop for themselves. The aim is not to be right about the future but to gain new insights about challenges and opportunities.

How could you use your own or existing scenarios?

1. Consider the key contributions that policy, management, scientific research, voluntary work or other contributions might make in the event of the given future occurring:
    - What would the critical demands for knowledge be?
    - What sorts of pressure might individuals and institutions be under?
2. Discuss the scenarios among your friends, associates, colleagues and, especially, people with very different perspectives:
    - Assuming this scenario will occur, what is the optimal contribution different individuals and institutions can make?
3. Consider signposts:
    - Assuming this scenario will occur, what is the optimal contribution different individuals and institutions can make?

IMPLICATIONS FOR RESEARCH AND DEVELOPMENT

There is a tendency for futures analysis to identify risks and threats better than opportunities. Some argue this is because opportunities are much harder to anticipate. It also can be argued that dealing with risks opens up opportunities. Our analyses suggest that Australian land management faces many challenges in the coming decades but that imaginative thinking can turn those challenges into opportunities for Australia to lead the world in environmental management and land-based industries.

As a research and development agency, Land & Water Australia is very interested in the future role of science in helping society identify opportunities and deal with challenges.

The role of science

The mere existence of research is no guarantee that it will be used effectively. Futures analyses suggest several ways in which the role of science in society could change.

Several of the anticipated changes in attitude and ways of working among future generations could see greater attention to complex environmental issues but shorter-term, riskier and more individualistic approaches to research and development. The most progressive among the next generation are expected to be less likely to accept simple and single-issue research and development to address what they now know to be complex social-ecological issues.

Generation X is supposed to be impatient for action, which raises questions about whether problems requiring long-term and painstaking collection of data will get the necessary attention. Progress may be faster but mistakes might be more frequent. The fate of the Australian environment may depend on the mechanisms put in place to monitor progress and learn from mistakes. This will be a key area for research and development in the near-term.

The workforce of the future will likely focus more on causal and short-term employment, and specialists may be less common. How will long-term studies be initiated and maintained? Will we risk losing intellectual capital as older scientists feel disenfranchised?

A likely implication of the ascendancy of Generation X is growing impatience with research and development that does not address policy and management goals. Research and development in recent years has been getting much better at identifying these objectives and what they mean for research design. Several high profile projects have shown that putting decision making and policy at the core of the research framework can have the advantage of exposing gaps in knowledge needed for good decisions but can have the disadvantage of stifling innovation and imagination.

KEY POINTS

- The role of science in society, and the way science is communicated, could change dramatically in the future — some of these changes are essential and useful, while others will be considered by some as threats to the integrity and objectivity of science
- We have suggested some ways in which research and development on natural resource management could help prepare Australia for plausible futures
- Likely and possible changes in attitudes and expectations in society could demand a revolution in approaches to communication and adoption of knowledge if we are to continue moving towards sustainable land management

The coming decades are likely to see increased professionalisation of politics (politics sharply honed to win votes using modern media and social technologies) and an increase in the role of skilled advocates to connect society with politicians. One challenge for science is to find ways to feed well-grounded scientific insights into this environment without compromising confidence in scientific method.

There are signs that trust in authority organisations, including science, may continue to decline. Interest is increasing in alternative ways to interpret the world, some of which will are ideologically driven. A major challenge for science will be how to make its insights about the world understandable and useful to society in this changing environment.

Issues for science in the future

Science may be required to be at the same time more outcome driven and better able to demonstrate achievement of intangible outcomes. Generation X is likely to place an even higher priority on user-pays approaches to environmental management and to be less tolerant of individuals or groups that do not deliver on promised outputs and outcomes. At the same time there is likely to be a shift away from income as the sole measure of success. Developing understanding and tools for measurement of impacts on tangible and intangible societal benefits will be a priority for research and development.

The loss of some of Australia's best young scientists to other countries is likely to be a continuing issue, especially if the focus is drawn away from research and development even further in Australia.

Perhaps the greatest challenge for environmental science is the apparent decline in confidence among civil society that a better world is achievable. This goes hand in hand with decreasing participation in public causes like improved environmental management. The key research has not been done to demonstrate the benefits of alternative land management and this is now a critical priority.

Likely trends

- new instruments for research;
- fringe theories will become mainstream;
- convergence of disciplines.

Uncertainties

- whether science will be designed to persuade, rather than to explore and enlighten;
- how strongly society believes that societal problems can be solved with technological innovations;
- nature of the global market for knowledge and services;
- nature and extent of research funding;
- whether we continue to develop technology that encourages one-dimensional approaches to solving production problems or move to a multi-dimensional systems strategy as the guiding principle of our natural resource management research agenda;
- whether English remains the global language of science;
- the public's confidence in science and reputation of science.

Possible surprises

- science loses its dominance and stagnates;
- science regains it prestige and the confidence of the public (possibly due to the role of science in resolving some major environmental issues in coming decades or to a major culture change seeing science better communicated and better understood across society).

Some difficult and provocative questions remain:

- Will scientific research be at the heart of policy?
- How will peer credibility fare versus immediate agendas?
- How can research help build new information/ knowledge environments?
- How will technology transform research?

There are signs that the way science is practiced in a world of rapid technological progress is changing. Some of the research on the human genome was published in leading scientific journals without full details because of commercial confidentiality. Will we see ongoing changes to the openness of science in the future under stronger commercial and possibly political pressure? Will this degrade or improve the contribution of science to society or just make it different?

Research and development challenges

We have identified a set of issues that we think are important for research and development to address to prepare Australian natural resource management for a range of plausible futures (see the table in this section). The reasoning behind these suggestions is explored in detail on the CD-ROM. We do not suggest that these are the only priorities for the future. Nor are they necessarily the most important. They are those that have leapt out at us from our review of future trends, drivers and scenarios. Our bias is towards the business of Land & Water Australia; that is, we are seeking to identify research critical to moving Australian landscapes and rural communities closer to ecological, social and economic sustainability.

As with the rest of this document, our suggestions are designed to encourage dialogue and deeper thinking, especially about where knowledge gaps might leave us unprepared for plausible futures.

Research to deal with changing attitudes and governance challenges could include:

- new institutional arrangements for natural resource management consistent with possible swings towards or away from central government, including reduction of the number of levels of government;
- the ways in which decision makers learn about environmental change;
- the costs and benefits of environmental management options (there are surprisingly few data here);
- policies for maximising market access that span the spectrum from access determined by 'what you know' (eg. certification systems, EMS — the European/ US approach) to 'who you know' (a move towards a more Asian way of doing business);
- possible trajectories of water markets, their legal implications, how they might intersect with markets for other ecosystem services, and what their broader social implications might be.

Research to deal with the complexities of social-ecological interactions in ways that are understandable and can be implemented by regional communities could include:

- a new generation of models of social-ecological systems that deal with sudden or uneven change in ecological and economic systems;
- what gives social-ecological systems resilience and adaptive capacity in the face of plausible future shocks;
- how to measure the fragility or robustness of ecosystems;
- how to define and measure human well-being in relation to environmental function;
- system-wide impacts (on social and ecological systems) of climate change and other major potential causes of landscape change;
- risks in relation to pests, diseases, eco-terrorism, eco-crime and 'connected' technologies as scenarios for globalisation, movements of people and goods, rapid emergence of new technologies, and convergence of technologies roll out in the future.

Research on future directions for rural and regional Australia could include:

- implications of periurban development for rural communities, agricultural industries and ecosystem services (expanded on below);
- new agricultural products as preventative medicines and nutriceuticals;
- on-ground research to understand the dynamics of native and crop systems to identify emerging opportunities (like the discovery of root diseases in grains and the benefits of soil biodiversity in horticulture);
- development of scenarios for future landscape management that are useful and meaningful to land managers and rural communities in a time of changing values and reliance on science;
- landscape impacts of biotechnology;
- alternative energy sources;
- potential social, economic and environmental impacts of IT on rural communities and industries;
- impediments and opportunities to establishing and maintaining value chains in rural industries;
- how uptake of technologies can be improved and how rural and regional communities can be prepared for potentially rapid changes in market demands and technological competition.

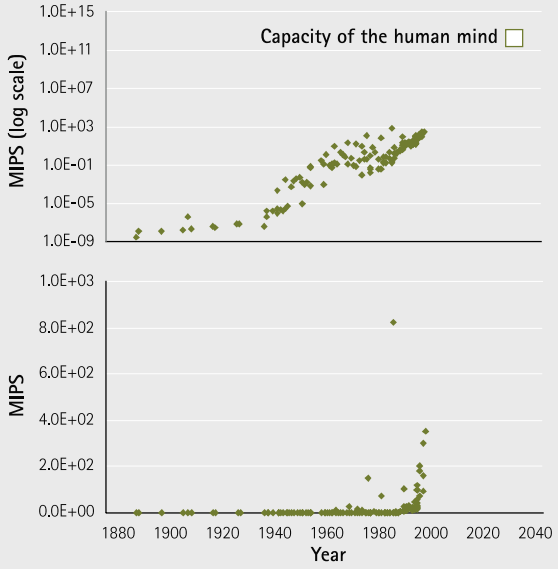
Summary of major research and development issues identified in our analyses and a rough indication of how much effort (High, Medium or Low) is being directed to them in Land & Water Australia and other organisations. Asterisks identify where past and new investment by Land & Water Australia has been focussed. More detail can be found on the CD-ROM.

R&D challenge	LWA	Other
Understanding changes in attitudes and governance		
New institutional arrangements	M*	L
The way that decision makers learn	L*	M
Demonstrating benefits of environmental management	M	L
Approaches to maximising market access	L	M
Possible trajectories of water markets	M	L
Making the complexities of social-ecological interactions tractable for regional communities		
A new generation of social-ecological models	L*	M
Resilience in social-ecological systems	L*	L
How to measure the robustness of ecosystems	L	L
Measuring human well-being in relation to environmental function	L*	M
System-wide impacts of climate change	L	L
Risks from globalisation and technology	L*	L
Substitutions between dryland and irrigation	L	L
Future directions for rural and regional Australia		
Implications of peri-urban development	L*	L
Preventative medicines and nutriceuticals	L	M
Dynamics of native and crop systems	M	M
Regionally useful scenarios for future landscapes	L*	L
Landscape impacts of biotechnology.	L*	L
Alternative energy sources	L*	M
Impacts of IT	L	M
Impediments to food/ value chains	L	M
Improving uptake of technologies	M	M

A Singularity

The speed at which we can make calculations has increased hugely since the days of hand calculation and early calculators. With the advent of computers the rate is doubling every 18 months. The points on the graph relate to a wide range of different calculating devices, including many models of computers over the past 40 years. By about 2030 it is expected that computers will have computational capacity equal to the human brain. This, of course, raises all sorts of questions about what we might do with computers, what we might do with human brains, and about ethical issues. But as we approach 2030, things could be changing so quickly that society, including industry, could have trouble keeping up with the possibilities. This is called a 'singularity'. Singularities are possible in many areas of technological development and they could affect natural resource management and policy and rural communities just as much as other sectors of society. How will Australia keep pace with other countries that have younger and more adaptable labour forces? How will we cope socially? On the other hand, what great opportunities might arise? It is said that the future beyond a singularity is almost impossible to imagine — but we imagine some of the changes up till then, and build our capacity for major and rapid change.

Source: Moravec, H. (1998). When will computer hardware match the human brain? Journal of Evolution and Technology. Vol. 1 — March 1998, <http://www.transhumanist.com/volume1/moravec.htm>



The likely continued movement of people to the coast and other regional centres will pose infrastructural challenges that are well publicised. What does not appear to have been explored much is the flow-on impacts of this development. Location of urban and peri-urban development in relation to soils and rainfall could impact in many ways on rural industries and environmental quality, especially in relation to slowly-changing aspects of ecosystem function that might not show impacts for a decade or more.

Of particular interest is the convergence of disciplines like ecology, architecture and planning as way to surface challenges not apparent when the disciplines approach the issues separately. Questions that warrant research include:

- collection and synthesis of primary data and information on region-by-region outlooks on future population and land use trends;
- identification of key variables that might affect future trends;
- investigation of various scenarios for land-use in and around regional centres and exploration of their social, economic and environmental implications in the future.

Implications for adoption of knowledge

It is becoming increasingly clear that people across Australian society have diverse values and ways of understanding the natural world. Understanding this diversity and making environmental management broadly relevant will ultimately determine whether sustainable land management is achieved or not. A strong emphasis on translating scientific knowledge into the language and concepts of people who will implement it is not only essential but challenging. In the future, it will be important to seriously address the challenge of communicating with civil society and decision makers who often are not only unfamiliar with science but can be suspicious and even hostile to it.

We will need to acknowledge the existing challenge of low adoption rates of knowledge and technology across society (not just in rural Australia). This problem is most likely to intensify in coming decades if we come anywhere near the technological singularity (see 'Singularity' box) that many commentators predict.

Two related issues that dominate future scenarios developed in the past decade are the gulf between rich and poor and political and social unrest. These pose both threats and opportunities to natural resource management and research.

The threats are obvious. For example, risk of disruption to the Australian economy from terrorism, introduction of pests and diseases intentionally or unintentionally through movement of people across borders, and eco-terrorism. Apart from the direct impacts, these issues could take traditional aspects of environmental research off the political agenda in coming decades. Flexible strategies will be needed to keep mainstream research and development going and to capitalise on new, often short-term, opportunities.

The benefits are less clear, but no less significant. If efforts to improve the well-being and prosperity of developing countries are successful, then new and often unexpected markets could arise for Australian goods and ideas. Innovation is already emerging from developing countries like China and India, unencumbered by large investments in existing technologies and infrastructure. Australia has elements of the same advantage, especially if it can get industry investing in research and development. But it also has potential for new and exciting partnerships with developing nations.

Complacency is another theme of recent scenarios. It applies to agencies like Land & Water Australia as much as to Australia as a whole. It has been clear for some time that new approaches to research and development for sustainability are required to get more out of the funding available. The challenges of maintaining intellectual capability in natural resource management is not trivial. It would be easy to continue following standard approaches to research and development that have worked for decades. The evidence is accumulating that this strategy will not succeed for much longer. At a minimum, research and development agencies need to get better at identifying the questions that are critical for achieving progress towards sustainability and achieving better integration across disciplines where that is appropriate to address the critical questions.

What you will find on the CD-ROM

This booklet has barely scratched the surface of information on past and possible future trends affecting natural resource management. Hopefully, however, it has stimulated you to think more about the future and add your own insights.

The CD-ROM addresses all of the issues covered in this booklet and more. It is structured more on traditional futures analysis lines, with a section on drivers of change, a section on scenarios and other futures analyses, a section synthesising the information, and an extensive list of references with hyperlinks to web-based versions of documents where possible.

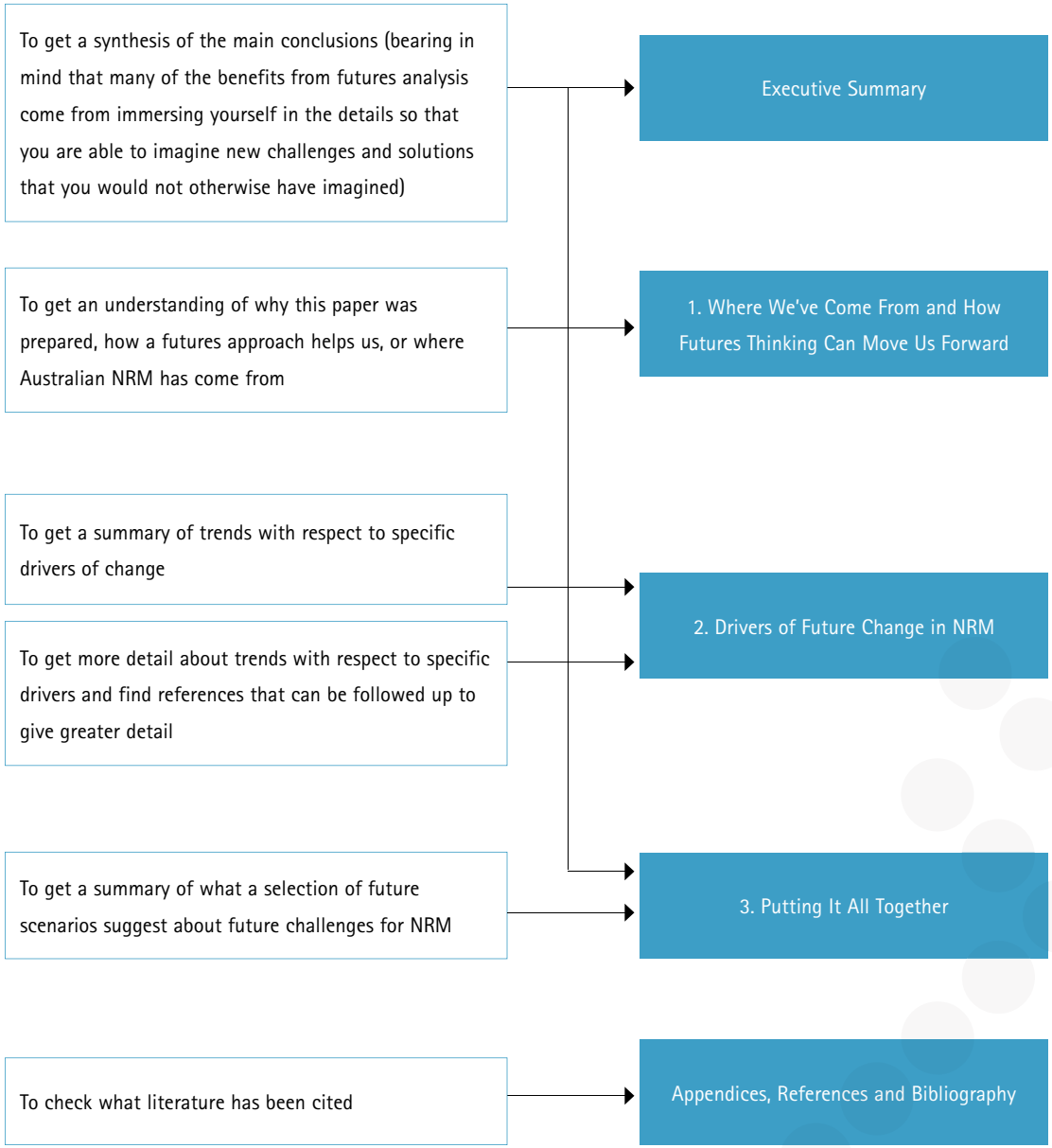
The CD-ROM is designed to be dipped into at any point for stimulation or to find information on a particular topic. It is a work in progress and will almost certainly have missed issues that some readers think are important. It will also have made a big deal of some issues readers think are unimportant. This is all good from our point of view. We hope you will give us feedback that we can use in updating the CD-ROM.

If you have feedback, please send it to:

Land & Water Australia
GPO Box 2182
Canberra ACT 2601
Phone: 02 6263 6000
Fax: 02 6263 6099
E-mail: LandandWaterAustralia@lwa.gov.au

We hope to be able to update the CD-ROM or a similar product in the future, so please give us your contact details if you would like to be kept informed.

How to find information on the CD-ROM...

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