Chris R. de Freitas
Martin Perry

New Environmentalism

Managing New Zealand's Environmental Diversity

Springer

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Preface

The Parliamentary Commissioner for the Environment, New Zealand's official environmental watchdog, identifies the geysers, thermal springs and sulphuric landscapes of Rotorua as among the most widely recognised and visited environmental features in New Zealand. It has reported that almost a third of all international visitors to New Zealand spend at least one night in Rotorua. Combined with day visitors, over four million people visit the locality each year or a number equivalent to the total New Zealand population. The country's 'thermal and volcanic' capital has been attracting people since New Zealand was first populated by Māori. Over 600 years ago, the Te Arawa people moved inland from the Bay of Plenty coast and settled in the Rotorua area. Their historic association with the region was recognised in December 2004 when Te Arawa were given ownership title to 13 lakebeds around the present day city of Rotorua. This transfer occurred as a consequence of the New Zealand government's recognition that past injustices had denied Te Arawa continued control of the resources that they had originally possessed.

The settlement was negotiated with the government's Office of Treaty Settlements. This agency was established to facilitate the larger redress of Māori grievances arising from the impact of European settlement during the nineteenth and early twentieth centuries. Treaty settlements recognise that promises made in a treaty agreed between Māori tribes and the British crown in 1840, which ceded New Zealand's sovereignty to the British crown, have frequently been dishonoured. Along with the title to lakebeds, Te Arawa received an agreed historical account and Crown acknowledgement of past misdoings, an apology and financial compensation. Ongoing effort will be needed to return the lakes to their condition first enjoyed by Te Arawa.

Rotorua's lakes are badly affected by eutrophication, although some more so than others. As reported by the Parliamentary Commissioner for the Environment, water quality in the lakes has been declining for 30–40 years and for some lakes toxic algal blooms are a serious problem. Depending on which strain of cyanobacteria cause the bloom, the visibility and toxicity can vary but frequently a pea-green soupiness is evident. The pollution is a consequence of nitrogen and phosphorus entering the lakes, principally from agricultural activities in their catchment. In recent years, much of the increase in nitrate load has come from streams that drain agricultural land. From dairy farms, for example, cow urine and other waste that contains nutrients (particularly nitrogen) leach down through the soil into the groundwater. It may take years for such pollution to travel through to the lake but the nutrient content is not lost and because of historic accumulation no immediate end to the problem is envisaged whatever the change to land use around the lakes today.

Scientific evidence of the gradual deterioration of one of the lesser affected lakes has existed for over 20 years but only since 2000 have concerted efforts started to improve the situation. Under the umbrella of the Joint Strategy Committee and the Rotorua Lakes Protection and Restoration Programme, local authorities and the Te Arawa Māori Trust Board are developing long-term and immediate action plans.

For the present, the story is illustrative of some aspects of New Zealand's larger environmental challenges. The superficial appearance is of a green environment, but some of that greenness is a product of farming practices that have significant, damaging side effects. Resolving the situation is not straightforward as major changes in land use are implied. Moreover, whatever the immediate steps taken, the situation is likely to worsen before it improves accentuated by the slowness in acting when the issues were first recognised. Positively, concerted efforts are being made motivated by the desire to make the water safe for human and animal contact, helping to protect the economically important tourism industry, and from recognition of the spiritual and cultural significance of the lakes to Māori. On this basis, the Parliamentary Commissioner for the Environment is optimistic for the future of the lakes provided that the team effort to address the problem can be sustained over 'at least a 50 year journey'.

This book offers an introduction to New Zealand's larger environmental management challenge. It is designed to support introductory teaching in universities and other tertiary institutions. The book aims to be of interest to a wide range of courses including environmental science, environmental management, economics, public policy and business. To this end the book encompasses descriptions of key agencies and laws governing the management of the environment, discussion of alternative ways of designing environmental regulation and a review of the state of the major types of environment. The discussion is framed by two main assumptions. First, evaluation of the state of the environment is affected by the events and expectations current at the time of the evaluation as well as by the level of scientific knowledge and availability of environmental data. Second, that New Zealand's environmental challenges pose enormous management challenges that for the most part belie any straightforward solution.

The first of these assumptions is reflected partly in our concept of a 'new environmentalism'. This short-hand term summarises three distinct but inter-connected trends that are seen to be framing contemporary discussions of environmental sustainability: declining resources, radical transparency and increasing expectations. These features are developing at different rates and with varying consequences in different places around the world, but collectively they provide a new context in which New Zealand's green credentials are being evaluated. Whereas in the past, participation in wilderness conservation and pollution control went a long way to satisfying environmental obligations, the new environmentalism poses new challenges that threaten some aspects of the country's environmental scorecard. It will be argued that new environmentalism captures a set of issues that provide much of the current agenda for environment management. At the same time, it will be recognised that traditional environmental concerns have not gone away and that it remains to be seen how enduring and coherent the new regime will prove to be.

The second assumption is partly in contradiction to the first. Many environmental challenges are particular to the places where they occur. This is partly illustrated in the unusual aspects of New Zealand's contribution to greenhouse gases in which agriculture rather than industry or human population is a major source. This matters because many policy prescriptions rely on encouraging the adoption of cleaner technology. When it comes to the major sources of New Zealand's greenhouse gas emissions, alternative technologies do not yet exist short of a shift to less intensive forms of production. The particular environmental challenges faced are also partly an outcome of the island geography which has supported highly endemic species. Measured by the proportion of its wildlife under threat of worldwide extinction, New Zealand can be considered among the worst environmental performers. Examine New Zealand according to the proportion of its land area protected from development and it can be considered an environmental champion. The contrast is partly that the protected areas do not give good representation of the diversity of environments that need to be saved.

The idea for this book evolved from recognition of the need for a critical account from an interdisciplinary perspective of how New Zealand is tackling the trade-off between economic development and environmental protection. The authors combine a diversity of academic specialisations. Chris de Freitas is an environmental scientist with a particular interest in the atmosphere as environment, including climate change and impact assessment, atmospheric hazards, and microclimate processes of particular environments. Martin Perry is a human geographer and urban and regional planner currently teaching business and the environment in a School of Management. This is a jointly written book but some individual chapters are mainly one author's work (Martin Perry Chaps. 1, 2, 3 and 9; Chris de Freitas Chaps. 5, 6, 7 and 8). Acknowledgement is due to Victor Savage (Department of Geography, National University of Singapore) who provided the initial idea for the book.

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Abbreviations

$\mu g\ m^{-3}$	Micrograms per cubic metre
7SS	Seven Station Series
BRIC	Brazil, Russia, India and China
CBRC	Coastal Biogeographic Regions Classification
CDM	Clean Development Mechanism
CEF	Community Environment Fund
CER	Certified Emission Reduction
CFCs	Chlorofluorocarbons
CH_4	Methane
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CMCA	Common Marine and Coastal Area
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
CRI	Crown research institute
DoC	Department of Conservation
EECA	Energy Efficiency and Conservation Authority
EEZ	Exclusive Economic Zone
EMS	Environmental Management System
EPA	Environmental Protection Agency
EPI	Environmental Performance Index (Environmental Performance Indicator)
ERMA	Environmental Risk Management Authority
ETS	Emissions Trading Scheme
EU	European Union
E3	Equipment Energy Efficiency
GDP	Gross Domestic Product
Gg	Gigagrams
HAB	Harmful Algal Bloom
HSNO	Hazardous Substances and New Organisms Act

ITQ	Individual transferable quota (ITQ)
LTCCP	Long Term Council Community Plan
LULUCF	Land use, land-use change and forestry
MAF	Ministry of Agriculture and Forestry
MARPOL	Convention on the Prevention of Pollution from Ships
MEC	Marine Environment Classification
MED	Ministry of Economic Development
MfE	Ministry for the Environment
MSY	Maximum Sustainable Yield
MW	Megawatt
NAIT	National Animal Identification and Traceability
NGO	Non-governmental Organisation
NIWA	National Institute of Water and Atmospheric Research
NO_x-N	Oxidised nitrogen
NPS	National Policy Statement
NZBCSD	New Zealand Business Council for Sustainable Development
NZCIC	New Zealand Chemical Industry Council
NRWQN	National Rivers Water Quality Network
NSP	Neurotoxic Shellfish Poisoning
NZCPS	New Zealand Coastal Policy Statement
NZGBC	New Zealand Green Building Council
NES	National Emission Standard
NO	Nitric oxide (NO).
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NZEECS	New Zealand Energy Efficiency and Conservation Strategy
NZETS	New Zealand's Emissions Trading Scheme
NZTER	New Zealand Transport Emission Rate Model
NZTR	New Zealand Temperature Record
O_3	Ozone
OECD	Organisation for Economic Cooperation and Development
OSY	Optimum Sustainable Yield
Pb	Lead
PM_{10}	Fine airborne particles of less than 10 μm diameter
$PM_{2.5}$	Fine airborne particles of less than 2.5 μm diameter
PRE	Projects to Reduce Emissions
PCfE	Parliamentary Commissioner for the Environment
PCBs	Polychlorinated biphenyls
PCDDs	Polychlorinated dibenzo-p-dioxins
PCDFs	Polychlorinated dibenzofurans or
PCE	Parliamentary Commissioner for the Environment
QMS	Quota Management System
RMA	Resource Management Act
SHORE	Centre for Social and Health Outcomes Research and Evaluation
SME	Small and medium-sized enterprise

SO_2	Sulphur dioxide
TRI	Toxic Release Inventory
UNCLOS	United Nations Law of the Sea Convention
VOCs	Volatile organic compounds
WCED	World Commission on Environment and Development
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
YCELP	Yale Center for Environmental Law and Policy

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Chapter 1
The New Zealand Environment

Key Questions

- What are the origins of New Zealand's physical environmental characteristics?
- Does New Zealand's distinctive environment give rise to special responsibilities?
- What trends are influencing the development of a 'new environmentalism'?
- How does 'new environmentalism' affect New Zealand's ability to gain an economic advantage from its reputation as a green economy?
- How good an environmental reputation does New Zealand deserve?
- In what ways does a popular perception that New Zealand's environment is in good condition and is well protected become a barrier to strengthening environmental management?

Abstract This book addresses three key questions. What are the main threats to the quality of New Zealand's environment? How are these threats being dealt with? How is the state of New Zealand's environment to be judged? This chapter sets the context by explaining how New Zealand's ecological evolution in relative isolation from other ecosystems has left special environmental challenges including vulnerability to invasive species as well as the 'normal' pressures on the environment from the growth of population and economic activity. Internationally, three trends are tending to focus more attention on the state of environment: declining resource availability, increased transparency and increasing expectations. New Zealand is affected by this 'new environmentalism' which puts its green image under growing threat. Although some environmental stresses have been reduced, many of New Zealand's endemic wildlife remain under threat as habitat ecosystems are damaged or destroyed and invasive species spread. The serious nature of these problems questions whether enough is being done to protect the environment.

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Key Concepts and Terms Clean and green • Ecosystem • Endemic • Environmental management • Environmental Performance Index • Gondwana • Kaitiakitanga • New environmentalism • Traceability • Treaty of Waitangi

1.1 The Setting

New Zealand's geological origins are as an isolated remnant of the prehistoric super continent Gondwana. That once enormous southern continent, to which Africa, Antarctica, Australia, India and South America also owe their origins, fractured in stages. Present day New Zealand started to drift away from Gondwana about 85 million years ago. Prior to that, New Zealand and South America were connected through Antarctica from which has been left a common heritage to some New Zealand and South American plants and animals. After separation, New Zealand and Australia remained sufficiently narrow for some animals to transfer up to about 60 million years ago. Subsequently, the Tasman Sea has remained at around its present size leaving New Zealand to evolve in comparative isolation. Much of New Zealand's distinctiveness can be explained by its separation occurring prior to the evolution of many animal species. The absence from New Zealand of many of the animals that shaped the ecosystems of other land masses resulted in the evolution of a unique population of birds, insects and reptiles. Excluding marine life, many of the species surviving in New Zealand have no representation elsewhere (Wilson 2004). Consequently, judgements on New Zealand's environment performance will vary according to the extent to which it is expected that this unique heritage is protected or whether the goal is simply to preserve scenic attractiveness.

The ancient and unusual Godwana wildlife, such as the flightless kiwi, are among the most widely recognised aspects of New Zealand's environment. The physical environment can get less attention, but it is equally distinct because of its newness and diversity (Molloy and Smith 2002). In geological terms, New Zealand is a new born. Over the 80 million years or so of its geological independence, the landscape has been reshaped by volcanic, seismic and glacial events. Thirty five million years ago, the land mass had eroded to a chain of small islands with an area of land about one fifth of New Zealand today (Cooper and Cooper 1995). A period of volcanism and mountain building commenced about 20 million years ago, caused by the collision of the Pacific and Indian-Australian tectonic plates. At the boundary of these plates, New Zealand's land use continues to be affected by the consequences, most recently in the 'red lining' of parts of urban Christchurch following the earthquakes of 2010 and 2011. The terrain encountered today has mainly been formed in the last two to three million years, although some prominent features are of considerably more recent origin. Ngauruhoe, the youngest of the three central North Island volcanoes, has a current altitude of 2,291 m but was considerably smaller when first sighted by humans. Rangitoto Island dominates the vista from Auckland eastwards today but emerged from the waters of the Hauraki Gulf after Māori had settled the region about 600 years ago. Travel north out of the capital Wellington and the road is on land uplifted from an earthquake in 1855 (Molloy and Smith 2002).

Fig. 1.1 Map of New Zealand showing topography and key locations mentioned in the text

New Zealand's two main islands are fringed by clusters of small to moderately large islands numbering around 700 in total (Fig. 1.1). Some of these islands were once connected to the main islands, while further offshore are oceanic islands that have never had a mainland connection. Surrounding New Zealand's land mass is the world's fourth largest exclusive economic zone, giving a small country stewardship of a huge area of ocean. The land area is relatively small (270,000 km^2) but with a diversity that is found usually only at a continental scale. As well as the straddling of tectonic plates, other aspects of New Zealand's position on the globe explain the mixing of natural landscapes. Tectonic uplift produced mountainous landforms that intrude into the path of the winds and oceanic currents that encircle the middle latitudes of the Southern Hemisphere from west to east (Molloy and Smith 2002).

Over 60% of the country lies above 300 m altitude and 70% is classified as hilly or steep. Most of the mountains are in the South Island including a continuous chain of high peaks. Moist westerly winds bring snow and rain. Ocean currents continuously erode the coastline and shift material in their wake. The western parts of the South Island are especially wet where high mountains are in close proximity to the coast. Up to 15,000 mm a year of rainfall is not unusual in some parts of the westward facing Southern Alps, making them among the wettest places in the world.

The newly created landscape has been a boon for scenic and adventure tourism. Less advantageously, the new landscape proved fragile when European settlers sought to intensify agricultural production. Agriculture was the focus of attempts by the colonising population to establish a profitable economic base. The invention of refrigerated shipping in the late nineteenth century gave this some hope. It permitted the export of frozen meat and butter that became the mainstay of the New Zealand economy over the next century. The trade encouraged a process of land development, but by the 1920s the natural limit of land that could support animal grazing had been reached and farming pushed right up to, and in some cases, beyond its ecologic limits (Brooking et al. 2002). The productivity of soil declined dramatically once the initial fertility of converted land was worked out, compounded by regenerating bush and widespread soil erosion. Agricultural science and the extensive use of herbicides and artificial fertiliser, much of it dropped from aerial topdressing planes, together with a post war boom in commodity prices, led a revival of the agricultural economy. Prior to the 1940s, sheep numbers peaked at around 30 million. By 1982, a new peak of 70 million was achieved with only a minor increase in the area of cultivated land although by now 51% of the land area had been converted to grassland (Brooking et al. 2002: 171). Faith in the possibilities of science and technology to harness New Zealand's 'natural advantages' continued with little questioning at least up to the 1980s. Subsequently, awareness has grown of the need to modify some farming practices, but only after this was demonstrated by a number of environmental disasters as well as greater acceptance of the viability of organic farming (Box 1.1).

Box 1.1 Case Study: Cyclone Bola

New Zealand is close to the southern limit of tropical cyclones that regularly form in the South Pacific during the period November to April. In March 1988, one of the most damaging extra-tropical cyclones known to have hit New Zealand struck the Hawke's Bay and Gisborne-East cape region. It resulted in up to close to a metre of rainfall over 3 days and winds of over 100 km per hour. As many as 1,765 farmers were affected by soil erosion and flooding damage. Steep hill country used for pastoral farming proved especially vulnerable and was seen to expose the need for more attention to soil conservation and river control. In the aftermath of the cyclone, government sponsored large scale forest planting on land formerly used for sheep grazing took place to help stabilise the land.

(continued)

Box 1.1 (continued)

Critical thinking question: Should the New Zealand government assist hill country farmers better manage their land use to prevent erosion or should hill country farmers pay an environmental charge for the erosion risk created by their farming?

The end result of a mix of geological inheritance and human interference is a mosaic of landscapes. These range from extensive urban environments and heavily modified rural environments, through those which are modified but retain a natural appearance, to remote areas of relatively unmodified natural vegetation, much of it protected as national parks although still affected by the depredations of exotic species. This diversity needs to be kept in mind when looking at the results of national assessments of the state of the environment. Tools such as environmental footprint analysis (discussed further in Chap. 4) are attractive because they give a national score for international comparison, but in New Zealand's case, the state of multiple separate ecosystems needs to be evaluated and not just the overall demands on the physical environment.

1.2 New Environmentalism

Progress in the management of New Zealand's diverse ecosystems can be judged partly in terms of the extent to which it is keeping pace with changes in social and economic expectations. Of course, to some people, the concept of environmental management suggests human arrogance. They argue that the environment can manage itself and it is humans that need managing. This perspective represents a fundamental challenge to our modern way of life and can overlook that the legacy of past human interference with the environment needs to be managed as well as impacts that may be affected by current activity. For most people, it is acknowledged that human use of natural resources incurs environmental costs and the task is to minimise those impacts.

In the past, the main goal of environmental managers was to minimise environmental costs or impacts through preservation, conservation, and restoration. Preservation is about excluding human presence as far as possible so as to ensure a natural area is as fully protected as possible. Conservation seeks to minimise human impacts on the area under protection but may not demand complete exclusion, as in the way National Parks and also places of recreation and tourism. Restoration aspires to reinstate or repair degraded environments and as far as possible return them to their original state. New Zealand, for example, has a long history of species reintroductions as a means of ecological restoration, especially of islands following the eradication of foreign pests. Over the 40 years post 1960, nearly 260 species transfers involving at least 66 animal species were documented (Craig et al. 2000).

These concepts remain useful, but environmental management is now accepted to extend to more than safeguarding or restoring remnants of natural animal and plant communities. Plants and animals, including humans, interact together and with the inanimate substances of the biosphere (atmosphere, soil and water) in ways that are constantly changing with each element and species impacting directly or indirectly on others. The problem is that in the modern world, humans have a capacity to change the dynamics of all ecosystems at a rate and scale that can lead to their demise. The challenge of environmental management is striking a balance between the needs of Earth's ecosystems and the needs of humans as one of Earth's inhabitants. This challenge is being shaped by a 'new environmentalism'.

Laszlo and Zhexembayeva (2011) identify three big trends that are changing the rules for profit and growth in wealthier countries: declining resources, radical transparency, and increasing expectations. Arguably these trends are not just affecting the way more and more businesses across all sectors of economies are being forced to rethink their strategies, they are also affecting the targets and methods of public agencies and align with much public thinking. Collectively the trends are shaping the new environmentalism.

1.2.1 Pressured Resources

The availability of certain natural resources and degradation of natural environments is at the heart of environmental concern. There is nothing new to this concern. In comparatively recent times, for example, the 1972 Club of Rome's *Limits to Growth* report (Meadows et al. 1972) argued that prevailing consumption trends were leading to the exhaustion of many of the resources on which modern economies depend. Such warnings have been condemned as premature and exaggerated and too dismissive of the extent to which technological progress at least pushes back the time when Earth's resources are at their limits. This debate goes on as, for example, with the differing assessments over whether the point of 'peak oil' production has been passed and what it means if it proves to be the case that oil availability has started to decline (see Busch and Shrivastava 2011). There is no sense in which it is now agreed that resource scarcity requires immediate adjustments in economic activity. For Laszlo and Zhexembayeva (2011: 9–10), evidence of the number of companies turning to unconventional but environmentally sustainable resources on which to base an enterprise is evidence of a watershed having been crossed. More broadly, it can be claimed that pressures on a number of specific resources are encouraging a change of outlook.

Heavy use of non-renewable, carbon-based fuels and its link to global climate change is arguably the single most influential issue driving concern with the state of the environment. An acceptance of a carbon dioxide crisis is reflected in the agreement among industrial economies that led to the United Nations Framework Convention on Climate Change (UNFCCC) and its 1997 Kyoto Protocol that established differentiated national or regional emission reduction or limitation targets for carbon dioxide and five other greenhouse gases. As well as the climate change impact, the carbon issue has galvanised action because it links with concern over energy security. New Zealand's low dependency on fossil fuel for energy generation is unusual compared with most other high income economies. All forms of renewable energy account for around 13% of total energy consumption only with sources such as wind, solar, wave and geothermal accounting for around 0.5% only (United Nations Environment Programme and New Energy Finance Ltd 2007). With new energy demands driven by the growth of the BRIC (Brazil, Russia, India and China), the world's primary energy the United Nations has forecast that demand will be 40% higher than in 2007. Price volatility and geopolitical dependence on a few regions of the world are growing risk factors for older industrial economies. This is encouraging a shift toward greater energy self-sufficiency and while this does not exclusively rely on more renewable energy, unconventional sources of gas are of growing importance too, renewable are part of the agenda. With questions asked about the safety of nuclear power generation following the melt down at the Fukushima plant in Japan, the move into environmentally safe sources of energy has gained added impetus.

Food security is another area where there is growing acceptance of a need for ensuring that production demands are more compatible with environmental limits than they are presently. Once again this does not lead to a unified understanding of what constituents a more sustainable trajectory for food supply. Among environmental campaigners there are different priorities for those who support international sourcing of food commodities based on fair trade and those advocating the increased localisation of food production and consumption (Morgan 2010). Others are optimistic that genetic modification of food crops will raise the productivity of industrial forms of agriculture. A unifying theme is acceptance that more uncertainty surrounds the world's food supply than once it did.

Laszlo and Zhexembayeva (2011) highlight two further trends to illustrate their claim that the world's resource base is under growing pressure.

- The availability of freshwater supply to satisfy demand from human populations and agriculture.
- The decline of biodiversity which is a loss because of the intrinsic value of other living species, the degradation of surviving natural ecosystems when component species are lost and through the loss of species of potential value to human populations. The Millennium Ecosystem Assessment confirms the rapid decline in biodiversity over the twentieth century: it reports that humans have increased species extinction by as much as 1,000 times the rates typical over the Earth's history.

For New Zealand, pressure on resources brings varied outcomes. Some resource pressures put New Zealand in a favourable position compared with other OECD economies. Energy generation includes a high share from renewable resources and although there are constraints on maintaining this in terms of hydropower there has been an expansion of geothermal power. Similarly New Zealand is well endowed with water, but making this available requires investment in infrastructure and controls on water use in some local areas. World demand for food is generating high prices for New Zealand's agricultural commodities and encouraging a shift to higher value forms of farming, particularly toward dairy production. As later chapters explore, this is leading to increasing pressure on the environment and resulting in environmental impacts that are hard to mitigate. The larger issue is that even where New Zealand is well positioned to adjust to some resource pressures it is exposed to increased price volatility, changes in input costs and the need for other economies to face the natural resource crunch.

1.2.2 Radical Transparency

The context for environmental management has changed with the development of information technology and its impact in enabling greater transparency in the environmental performance of business and public agencies. This impact is partly voluntary as organisations take advantage of the increased ability to monitor and communicate information and partly a reaction to the growth in environmental activism that makes it harder for organisations to hide their environmental performance. The technological capacity to share information continues to grow suggesting that adjustment to a new era of transparency is still unfolding. Laszlo and Zhexembayeva (2011: 11) refer to the example of Gapminder to illustrate how more people and groups now have comparatively easy access to previously unattainable or severely restricted information that can be used to empower environmental campaigns.

Gapminder is a free and open online resource that aims to encourage 'fact-based world views'. As well as databanks on a wide range of social and environmental issues including carbon dioxide emissions since 1820, Gapminder gives users guidance on analysing large datasets. This comparatively easy access contrasts with a time in the recent past when environmental data for large parts of the earth were available only to major international organisations and others had to rely on their interpretations of the data or willingness to share raw information. As well as the scope for informed community activism, Laszlo and Zhexembayeva (2011) suggest that low cost global communications are creating a new level playing field for environmental campaigners. A company's social and environmental impact is now less likely to go unnoticed today than previously it may have been. This is especially likely where the mainstream media are among the groups making use of the new access to information rather than it relying on campaign groups alone. The impact of radical transparency is said to be behind the speed with which global food companies such as Kraft, Nabisco and Nestlė reduced their use of trans fats in the face of health risk concerns. This is certainly a contrast to an earlier time and the reaction of tobacco companies to scientific evidence of the dangers of smoking although modifying recipes is less of a challenge than dealing with an inherent defect that cannot be removed short of ceasing production.

The Toxic Release Inventory (TRI) in the United States is widely cited as an example of the ability of information transparency to pressure organisations into modifying their activities. The Environmental Protection Agency administers the TRI and is reported as regarding the programme as one of the most effective environmental initiatives ever undertaken in the USA (Graham and Miller 2001). It came into being following the devastating chemical accident at the Union Carbide plant in Bhopal, India in 1984. It was intended originally as a mechanism for improving the understanding of potential risks from industrial facilities. Subsequent experience indicated that reported toxic releases were reducing with a drop of 46% over the first 11 years of disclosure. With this evidence of the apparent power of transparency the programme's coverage has expanded and increased efforts made to release information in ways that community groups and individuals can make use of to monitor the use of toxic chemicals in their locality. At the same time, investigation of the TRI and other information sharing initiatives indicates that it is important to recognise that multiple influences are frequently at work, some of which may have nothing to do with increased transparency (see Chap. 2). Environmental information can be complex and open to alternative interpretations. This can make it important that there are intermediary agencies in existence to process raw information into more useable and insightful forms. But it also seems that organisations are developing increased sensitivity to the risk of being exposed as a poor performer. One reason for this is that competitors may include responsible companies who are choosing to harness the power of transparency, fostering innovation, customer loyalty and brand awareness (Laszlo and Zhexembayeva 2011: 14–15).

Increased capacity for connectivity is certainly a feature of the IT-enabled world that is opening business activity to higher levels of scrutiny than in the past. Icebreaker is a New Zealand example that has gained international attention (Fifield 2010). Buyers of new Icebreaker clothes are given a reference number or 'baacode' with a garment that enables them to view online the farm where the merino wool was grown. Links include a video of farmer Ray Anderson who tells how his family has run Branch Creek station for more than 100 years. Icebreaker says they persisted with the expensive and technically challenging project because a growing number of consumers demand proof of a company's commitment to the environment before they are prepared to buy.

Icebreaker is not alone in allowing this kind of product verification. It is a form of transparency that many producers who are confident of their environmental performance are seeking to earn an advantage from. Use of the new capacity for tracking back to upstream suppliers is spreading, helped by it being a tool for increasing supply chain efficiencies as well as for enabling traceability and demonstrating environmental responsibility. In New Zealand, for example, the National Animal Identification and Traceability (NAIT) standard makes radio frequency identification tags mandatory on all beef cattle from October 2011. Projects like this do suggest that poor environmental performance is going to be increasing hard to hide. If you do not make information about your supply chain publicly available, it appears that the chances are increasing that consumers will do it for you (Tyrrell 2010). They are being aided by technologies such as GoodGuide, an online database of qualified information about the health, environmental and social impact of 65,000 common products. GoodGuide was founded in 2007 by Dara O'Rourke, a professor of environmental and labour policy at the University of California, Berkeley. It uses a team of scientists and technologists to vet products in four categories: food, toys, personal care, and household products. Each of these products is rated and ranked on numerous criteria ranging from the harmfulness of its ingredients to its manufacturer's record on working conditions, diversity and reporting. The information is accessible via a website or an iPhone application, which can be used to scan the barcode of an item in the shop for instant feedback.

1.2.3 Increasing Expectation

As evidence of increasing expectations, Laszlo and Zhexembayeva (2011) put the focus on shifts in consumer demand in favour of organisations with sound social and environmental performance. This involves more than a preference for green label products. Indeed rather than a willingness to buy goods and services that overtly advertise (and charge for) their green credentials, more significance is seen in the number of mainstream products that are now combining price competitiveness with improved environmental performance over previously available offerings. Laszlo and Zhexembayeva (2011: 17) suggest that this shows how demand shifts when environmental and social advantages are embedded in a smarter product that does not require consumers to compromise on quality or price. Examples include innovations in the formulation and packaging of personal hygiene products such as hair shampoos that are marketed on the basis of their functional advantages rather than the environmental gains they also bring. The optimistic interpretation is that incidentally more and more consumers will recognise and come to expect these dual gains from more of the suppliers they patronise. A trend they see as being reinforced as consumers also express this preference in their choice of employer.

On a bigger scale than this consumer driven shift in expectations, the OECD has promoted the idea that with appropriate steps taken future economic growth can be 'green growth' (OECD 2011a). It has explained the concept of green growth in the following way.

> Green growth is about fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities (OECD 2011a: 132).

In essence the concept considers that governments and business leaders now have it in their power to pursue economic growth and development while preventing environmental degradation, biodiversity loss and unsustainable natural resource use (OECD 2010: 13). This can sound like earlier claims of the possibility of promoting 'sustainable development' (see Chap. 4). It seeks to differ by offering a tangible agenda of measures to reconcile economic and environmental goals such as encouraging the uptake of clean technology and forms of business activity that help to resolve environmental conflicts. Exemplar activities contributing to green growth include renewable energy, smart electricity grid technologies, biofuels and waste minimisation and management enterprises. While the development of specific innovations is critical to green growth, a shift to low carbon energy and the diffusion of information technology solutions gives potential for a broader transformation of economic activity. Realising the potential requires the coordination of various economic actors, for example to ensure investment in economic infrastructure that is compatible with new technologies which in turn can imply a need for selected forms of government intervention to ensure that appropriate incentives exist to reward investment for the environmental gains it makes.

Underpinning green growth is a requirement for environmental externalities and market failures to be more fully incorporated within economic decision making. The OECD (2011b) sees this as partly achieved through government policy measures that change price signals such as environmental taxes, tradable permits and the removal of price subsidies that have harmful economic outcomes (Chap. 2 provides further discussion of these policy tools). Other forms of regulatory intervention are needed to recognise that market instruments work best when alternative technologies exist and when activities can be monitored and priced (New Zealand's difficulties in introducing a carbon dioxide emissions trading scheme for greenhouse gases illustrates this, see Chap. 2). As well, fostering innovation in green technologies requires that there is appropriate investment in public research to further scientific understanding in areas such as material science and biotechnology. The larger environment for technology transfer and innovation-based entrepreneurship may equally need public policy to ensure appropriate incentives are in place. Achieving green growth, therefore, involves more than add-on policies to promote environmental protection. The policy agenda is about bringing environmental considerations into economic decision making alongside the use of other resources including labour, machinery and intellectual property.

The OECD framework for thinking about green growth identifies four ways that traditional economic decision making needs to be modified (OECD 2011a, b: 23).

- Broadening measures of a society's wealth to encompass changes in the state of natural capital (for example taking note of deterioration or improvement in ecosystem integrity) and intangible assets (ideas and innovation) as well as the components that are focused on by existing measures of national economic wealth. This modification should help rationalise compromising on some areas of economic growth where the impact brings a net reduction in overall wealth. The OECD suggests that it will particularly help to raise awareness of critical thresholds, as where a modest expansion in one form of resource use is associated with an irreversible loss of another resource (for example where a small expansion in fishing depletes fish stocks below a level from which they can recover).
- Ensure that the dual value of natural capital is recognised. For example, iron ore deposits can be valued in terms of the resource value to the mining industry. They should also be valued in terms of the ecosystem services (to human and non-human populations) and amenity provided by the area of land that would be disturbed by mining the resource.

- Recognise a need for public policy intervention to ensure that appropriate investment in natural capital occurs. The OECD accepts that too much natural capital is not valued or is insufficiently valued, as where burning of fossil fuels occurs without a cost being paid for the use of the atmosphere to absorb the by-products of the burning. Valuation of natural capital should be a priority for public policy as too frequently households and firms lack incentives to modify current consumption even where this goes beyond the level at which renewable resources have chance to regenerate.
- Encourage innovation that pushes back the 'frontier' at which increases in consumption start to deplete natural capital below critical thresholds or otherwise cause significant deterioration in the quality of the environment. This may involve innovation that encourages resource productivity, as by increasing the ability to reuse materials in existing products before taking virgin resources, or innovation that enables a less critical resource to substitute for one that provides important but undervalued ecosystem services.

The green growth agenda is presented as a subset of the concern to achieve sustainable development rather than as a replacement for it (OECD 2011a, b: 11). The green growth agenda relies heavily on the assumption that economic activity will substantially reduce its impact on the environment once an appropriate price has to be paid for the use of the environment. Not everyone agrees that it is possible or desirable to value the environment in this way (Box 1.2). Promotion of green growth may nonetheless be considered evidence of increased expectations because it is being translated into operational policy proposals by a mainstream agency that has influence on government thinking. As well because the agenda is partly informed by the number of major international companies now building competitive strategies through investment in clean technology and that are viewing reduced environmental impact as a stimulus for innovation.

Box 1.2 Discussion Point: Valuing the Environment

Environmental economists recognise that the attributes to be considered when valuing resources are wider than those considered in conventional cost-benefit analysis (see Bateman 2000). Traditional economic thought sees value in those aspects of a resource that are of direct importance to humans. So, for example, a forest is valued primarily according to the timber value of harvested trees, the employment generated and recreational services provided. Environmental economists may extend this valuation by recognising three additional sources of value. The 'option' value recognises that there may be some people not currently using the forest but who might wish to at some future date and who are in theory prepared to pay something to keep their option of future use open. The 'bequest' value arises as some people wish to

(continued)

Box 1.2 (continued)

have the forest available for future generations to use even if they do not themselves make use of it. The 'existence' value comprises what individuals think about the innate right of the resource to exist. The desire to see an area of wilderness preserved may partly reflect how people value its role in helping to conserve wildlife and in supplying other ecosystem services. The 'total economic value' can be brought into decision making by requiring development proponents to demonstrate that their project could in theory fully compensate for all costs and still be profitable.

The limitation of this approach is that the purpose of valuation remains that of informing cost-benefit appraisals with the implication that if the calculated benefit of development is high enough, the costs should be accepted. This assumes that there is nothing different between natural and manmade resources: if new development is valued sufficiently it justifies exploitation of the environment. Environmental economists recognise that this is too simplistic and that incremental cost-benefit decisions bring the risk of depleting crucial life-sustaining environmental services. A way round this is to impose sustainability constraints on decision making such as a 'constant natural assets' rule under which the stock of natural assets is not allowed to be diminished. There is no agreement about how such a test could be put into practice. Pending agreement over how sustainability constraints are to be implemented, the danger is that partial valuations of environmental assets are allowed to influence decision making.

Critical thinking question: What costs and benefits should be considered when evaluating whether a new road through a National Park should be allowed? Is it any easier to express the monetary benefits in financial terms than it is the costs?

1.3 New Zealand and New Environmentalism

Should New Zealand feel encouraged or challenged by the heightening of concern over the state of the environment? An answer to this question depends partly on whether New Zealand is judged an environmental villain, paragon or 'also ran'.

The perception of New Zealand as a model of environmental management gained some credible endorsement in the 2006 Environmental Performance Index (EPI) prepared for the Davos World Economic Forum (Esty et al. 2006). That index placed New Zealand top of 133 countries using 16 indicators across 6 policy categories: environmental health, air quality, water resources, biodiversity and habitat, productive natural resources and sustainable energy. High performance was not uniform across the six categories. New Zealand was grouped with a set of mainly high income countries that did slightly better than other countries in terms of biodiversity and habitat protection and significantly worse in terms of natural resource management. This high biodiversity score contrasts with an earlier ranking for the 2002 World Economic Forum that placed New Zealand bottom of 142 nations with respect to biodiversity performance and nineteenth overall (YCELP 2002).

Unfortunately the 2010 ranking has New Zealand slipping to fifteenth behind some other small island nations (Iceland, Mauritius, Malta and Cuba) and with a score close to several much more densely populated countries including the UK and Germany (Emerson et al. 2010). New Zealand's position in this environmental league table was referred to by an industry lobby group 'Pure Advantage' launched in 2011 as evidence of the need for their campaign to persuade more businesses to pursue social responsibility strategies (see www.pureadvantage.org). From their perspective being fifteenth is not good enough and is risking the ability of business to promote their green credentials in international markets. This concern recognises that New Zealand's success in international markets depends partly on overseas consumers being convinced that the country is distinguished by its environmental stewardship.

A study estimating the contribution of New Zealand's 'clean green' image for the value of the country's exports is one illustration of a connection being made between the economy and environment (Ministry for the Environment 2001). The widespread use for export marketing of New Zealand's claimed environmental qualities provided the background to the study. It looked at three sectors for which environmental perceptions might be expected to be a significant influence on buying decisions: dairy produce, inbound tourism and organic produce. The report's findings affirmed the dependence of economic activity on the continuance of a positive environmental reputation. It judged that this reputation is worth at least many hundred millions of dollars when extrapolated to other sectors beside the three studied. At the same time, the study considered that the environmental premium being earned was fragile. It came about from New Zealand's comparatively low population density and consequent weak environmental pressures rather than because of positive actions, or a willingness to sacrifice economic returns for environmental gains. At the same time, it noted that overseas buyers were influenced more by the image of the environment than its real condition so that shifts in reputation can be greater than changes in actual environmental conditions.

The EPI ranking is something that business leaders are rightly concerned about perhaps more as something affecting the perceived rather than actual environmental conditions. New Zealand's rise and fall in the EPI is most directly indicative of how performance varies according to how environmental conditions are measured (Chap. 4 discusses this further). Changes in the way that the EPI has recorded biodiversity and habitat protection illustrate this sensitivity (Table 1.1).

When New Zealand's environmental performance is assessed from the perspective of the risk to its indigenous flora and fauna, it appears no country is as vulnerable as New Zealand. The focus on birds and mammals in the 2002 study highlighted the country's fragility as species diversity is low: New Zealand has only three native land mammals (three species of bat) and 104 native birds (Wilson 2004: 3). Most

Table 1.1 EPI biodiversity and habitat protection indicators 2002, 2006 and 2010

Biodiversity indicators 2002	Biodiversity and habitat protection indicators 2006	Biodiversity and habitat indicators 2010
Percentage of mammals threatened.	Ecoregion protection – evenness of protected area coverage by biome types.	Biome protection – degree to which at least 10% of each terrestrial biome is protected.
Percentage of breeding birds threatened.	Wilderness protection – the extent to which the country's wildest areas are protected.	Critical habitat protection – share of gravely endangered species receiving protection.
	Water consumption – percentage of territory that is affected by oversubscription of water resources.	Marine protected areas – share of exclusive economic zone under protection.
	Timber harvest rate – timber harvest as a percentage of standing forests.	

Source: YCELP (2002), Esty et al. (2006), Emerson et al. (2010)

countries with similar numbers of threatened birds are large tropical countries with far greater species diversity than New Zealand. With a small population, minor differences in the number of endangered species disproportionately worsen the league position when expressed as a percentage. Consequently, when examined from the perspective of the typical causes of species loss – pollution, harvesting, hunting and habitat loss – New Zealand appears to be an environmental leader as compared with when the proportion of native species under threat of extinction is measured. The 2010 measures of biodiversity and habitat protection have mixed implications. With a large exclusive economic zone and a relatively small area protected (see Chap. 7), the inclusion of marine protected areas measure drops New Zealand down whereas the critical habitat protection measure is sensitive to the situation of country's such as New Zealand that have many endangered endemic species.

In practice, New Zealand's environmental performance is hard to compare through an international league table as it has special responsibilities to discharge. New Zealand has been identified as one of only four island groups that are large enough to have sustained their own species evolution while having been isolated long enough to have evolved unique life forms (Diamond 1990). New Zealand is one of four places in the world that allows ecologists to study evolution independent from elsewhere on the planet: the others are Hawaii, New Caledonia and Madagascar with Madagascar (ranked 120 in 2010) the only other of the four unique island ecosystems ranked in the EPI. For example, birds are New Zealand's largest group of vertebrate animals of which 87% are endemic species. For most non marine animal and plant groups, at least 80% of species are endemic. In terms of size, age and physical isolation from other land masses, New Zealand can be considered the most important of these highly endemic environments (Diamond 1990; Wilson 2004). New Zealand is sufficiently close to Australia to receive animals carried on ocean and wind currents but in pre human times the environmental differences were sufficiently great to impede their survival. New Zealand did well in the EPI when wilderness protection was emphasised but arguably the uniqueness and precariousness of many endemic species makes it most important to monitor progress in species protection.

International comparison is also made hard by the particular nature of the key environmental threats. Legal designation of protected environments guards against deforestation and other contemporary human sources of destruction. Unfortunately, New Zealand's unique flora and fauna are now more frequently at risk from alien species that have arrived over the last 2,000 years. This risk is both direct, where indigenous species are predated upon and cumulative through the loss of pollinators and seed dispersers. The kiore (Polynesian rat) was the first invader to disturb the indigenous ecosystem, arriving by means uncertain. By the time Polynesian settlers arrived, dated to about 800 years ago, many small ground-dwelling birds, reptiles, frogs and invertebrates were already extinct. The new settlers brought crop plants from the Pacific Islands, but found a climate too cool for them to harvest. Instead they had to turn to hunting and fishing. Combined with the practice of clearing land with fire, environmental transformation accelerated. By the time of Captain Cook's visit to New Zealand in 1769, at least 40 species of bird had become extinct and a third of the forest cover had been destroyed (Wilson 2004: 5). When the Polynesians had arrived, over 85% of the country was forested. By 1840 when they started to be joined by significant numbers of European settlers, this had fallen to 53%. The European colonists commenced a new wave of agricultural settlement, brought more formidable predators than the small kiore and embarked on a determined effort to change the landscape and wildlife to something closer to their homeland. After two centuries of European contact (pre-settlement their impact had already commenced through the activities of explorers, traders and hunters of sea mammals), among other consequences have been the loss of a further 16 bird species and reduction of the lowland forest cover to isolated remnants.

Efforts to protect what remains of the indigenous ecosystem have intensified. Through intensive management of endangered species, a global extinction of a native vertebrate (as compared with the loss of local populations) has not occurred since 1965 (Wilson 2004: Table 5.2). This compares with an average loss of one species per decade post 1840, but the extinction phase consequent on European settlement is unlikely to be over. Various species survive only on small predator-free islands and unless continued intervention succeeds it is possible that all currently threatened or endangered species will become extinct during the present century (Wilson 2004: 133). The intensity of the management involved in keeping some species alive is extraordinary. The black robin, for example, was reduced to a population of five birds with a single breeding pair in 1979. Twenty years later this had revived to 200 after efforts that have become legendary in the history of wildlife preservation (see account by Butler and Merton 1992). When the conservation effort commenced, the surviving population was confined to 7 ha of forest on top of a cliff-bound island in the Chatham group. The survival management strategies included the transfer of the entire population to a neighbouring island judged more likely to sustain breeding. When the breeding success rate turned out lower than expected, removal of eggs for hatching by foster birds on other islands was required: a strategy that had no guarantee of working (Moyle 2005). All black robins alive today are the ancestors of a single pair which raises questions over the ability of the species to withstand future ecological changes. For the present it can claim the record for the lowest population size from which a species has been known to recover (Wilson 2004: 278).

The willingness to engage in such intervention as directed at the black robin can be explained partly by the rediscovery of a bird that had been thought extinct. In 1948, takahe were seen in a Fiordland sub alpine valley having been presumed extinct for 50 years. The rediscovery aroused such great public interest that the need for action to save it and other endangered species gained widespread support (Lee and Jamieson 2001). Equally significant is that after more than 50 years of management the species remains severely endangered. Captive rearing remains an important part of takahe management even though it reduces their capacity to recognise some important foods. Another challenge has been to determine where captive birds should be released. An assumption may be that the habitat where the species survives longest is its preferred location. In the case of the takahe it remains unclear whether remoteness from human population more than suitability explains where they survived and leaves unclear which environment should be focussed on to make their home. Even so, compared with some species the takahe survives with some independence. All known kakapo New Zealand's flightless parrot, numbering 131 in 2011 (compared with around 170 in the mid 1970s) are named and tagged to facilitate monitoring and research of the population.

The number and severity of New Zealand's endangered species gives rise to management dilemmas that continue to divide conservationists. At different points in time, management strategies have variously emphasised moving endangered species to threat-free islands, treating threats in situ, saving individual species or restoring the ecological communities to which they are connected (Wilson 2004: 316). A biodiversity strategy released in 2000 (Department of Conservation 2000) marked a shift toward an ecosystem focus. This can appear to indicate a step up in ambition over single species survival but in practice the transition is hard to make (Saunders and Norton 2001). Much of New Zealand's conservation effort necessarily remains targeted on individual species with the advantages that objectives and progress can be clearly identified. One favoured strategy has been to relocate endangered species to offshore islands that can be made free of predators. This option, partly made possible because most of the small islands are publicly owned, has given New Zealand an advantage over other parts of the world facing similar challenges such as Hawaii. Given some constraints on mixing relocated species, close to 100 islands are in use as some form of sanctuary. This is costly and still far removed from the ultimate target of conserving species in harmony with each other and their habitat. On the mainland, species survival often depends on the frequent use of large quantities of poison to eradicate predators. That management has met with growing opposition from the perspective that applying poison achieves only partial protection at the cost of killing native species as well as introduced predators (Innes and Barker 1999). With few options for eradicating pests in remote locations, the Parliamentary Commissioner for the Environment (2011) has endorsed its continued use.

Since the reappearance of the takahe, every known endangered species has had effort invested to protect it. Extinctions have been avoided but at the cost of less attention to other species that have more recently become endangered, including the iconic North Island kiwi (Wilson 2004: 333). In 2006, the Department of Conservation announced a review of the species to be prioritised for protection.

When attention shifts to the quality of the environment in which most people live and work, New Zealand's green credentials are stronger than when the state of the indigenous ecosystem is considered. Depending on which aspects of the environment are considered, this can own more to good fortune than good management. With a population of a little above four million, population density is low. As an island country with settlement concentrated at coastal locations, air quality is protected because of the rapid dispersal of air pollution from upwind sources. Around a third of country's energy consumption comes from hydroelectric or geothermal sources, helping to reduce some sources of pollution. With some environmental pressures minimised, there has been a tendency to believe that environmental conditions are better than they actually are (Wallace 1997; Hughey et al. 2004). While New Zealand does benefit from a relatively large area of land per person, each New Zealander relies on a comparatively large area of land to sustain their current way of living (Ministry for the Environment 1997: 3–3). Similarly, overall population density is low but over 80% of the population live in urban areas and almost half of these are located in and around the Auckland metropolitan region. While the population size is small in comparison with the primate regions of many other countries, Auckland is geographically larger than a city such as London that has seven times the population. Low density sprawl reduces some environmental problems but amplifies others such as those associated with the high dependence on private transportation.

One assessment made in the early 1990s suggested that New Zealand was afflicted by a 'clean green syndrome' (Bührs and Bartlett 1993). Excessive optimism about the state of the environment, they argued, slowed the willingness to regulate the use of environmental resources (see Box 1.3). This verdict may help explain a legacy of contaminated sites caused by the in situ disposal of chemicals without treatment (Szabo 1993); that in the early 1990s New Zealand had double the OECD average for the use of pesticide on arable and pastoral land (OECD 1996: 138); and that it was not until 1996 that leaded gasoline was banned from sale. On the other hand, environmental regulation was significantly reformed in the late 1980s and early 1990s with claims that New Zealand was at the forefront of efforts to enshrine sustainable development within its management system (Palmer 1995). The nature of this reform was to consolidate primary responsibility for environmental management with local authorities, mainly at the regional council tier of administration. The broad objectives and methods available to local authorities are set by national legislation, policy guidelines and standards. As well, issues that are thought to require a national response (such as nature conservation on public lands, endangered species protection, ozone layer protection and the introduction of hazardous substances and new organisms) have remained in central government's hands. The devolution in responsibility mainly affects the implementation of the environmental management system.

Box 1.3 Discussion Point: The Risks of Claiming to Be Green (Source: *Sunday Star Times* 12 November 2006; *The Dominion Post* 8 December 2006; 9 January 2007)

Tourism New Zealand has marketed New Zealand as '100% pure' with images to encourage international visitors to believe that New Zealand's environment is pristine, natural and uncrowded. As well as overlooking some serious environment quality issues, the campaign glosses over the significant environmental damage associated with international travel. Upwards of 250,000 holiday visitors travel to New Zealand from Britain each year with many others coming from elsewhere in Europe. As well as emissions from the burning of fossil fuel (including nitrogen oxides that form ozone) jet plane contrails (visible as long white streamers) encourage cloud formation that adds to global warming. As a rough guide, the full environmental damage of airline emissions is more than double the carbon dioxide emission.

A consultancy group The Providence Report released a study 'Code Green' in November 2006 that noted that no other country tells the world that they are 100% pure. In practice, they report that New Zealand's ecological footprint, measured on a per capita basis is only slightly behind that of the USA and ahead of Britain. The consultants claim that while large international firms such as the British supermarket chain Tesco and US retailer Wal-Mart take climate change seriously New Zealand's larger companies show little interest. With other destinations already more advanced in making their tourist industries 'carbon neutral', excessive optimism about the state of New Zealand's environment may ultimately damage the tourist and wider economy. In 2011, such concern was taken up by an industry lobby group 'Pure Advantage' who are campaigning for more New Zealand companies to demonstrate their commitment to the environment.

Critical thinking question: Should Tourism New Zealand change their marketing campaign and target visitors from countries near to New Zealand and domestic tourism only?

1.4 Māori and Environmental Management

As well as the ongoing challenges, the history of New Zealand's environmental transformation raises the question of who can be trusted to steward the land today. The arrival of people, and the accompanying rats and dogs, in the thirteenth century or thereabouts initiated a great assault upon New Zealand fauna (Anderson 2002: 28). Whether the first (Polynesian) or second (European) wave of settlement was most destructive is an issue that continues to exercise popular attention. It has particular consequence for the willingness of some New Zealanders to accept the contemporary environmental credentials of Māori (Young 2004). European settlement proceeded on the basis of the Treaty of Waitangi 1840. This struck a bargain between the British crown and Māori under which the crown was given the right to govern on the basis of an obligation to protect the existing use rights of Māori. This agreement has been respected to varying degrees. Since the 1980s there has been more effort to honour Māori expectations although concerns have remained that traditional knowledge is not afforded the respect it should. The Wai 262 claim was taken to the Waitangi Tribunal to rule on this matter. Its judgement was released in 2011 and considered that there was considerable shortfall in respecting Māori cultural values (see Chaps. 3 and 5). Responding to these expectations is part of the challenge of contemporary environmental management that adds to the distinctiveness of the country's experience.

Māori address the notion of environmental sustainability drawing on their own experience. Kaitiakitanga is a Māori environmental management system developed to protect the mauri (life principle) of taonga (valued resources) for sustainable use and management of natural resources. Kaitiakitanga involves the guardianship of natural resources and ecological systems in accordance with custom and tradition and defines the role of Māori to act as kaitiaki, the temporary guardians of the richness of all life and matter. In the kaitiakitanga world view, people do not own natural resources to exploit but are temporarily supported by Papatuanuku (Mother earth) to use and manage taonga. Kaitiakitanga might include restocking of pāua beds by the transfer of pāua from one area to another and the picking of harakeke (New Zealand flax, Phormium tenax) in a manner that ensures the conservation of harakeke for weaving and other practical uses (Wright et al. 1995; Kamira 2003). It can also be argued that the three pillars of sustainable development in the WSSD declaration echo the three principles of participation, protection and partnership that are enshrined in the Treaty of Waitangi (Pratt and Lowndes 2005).

Kaitiakitanga has some similarity to the Western idea of resources being harvested to their maximum sustainable yield, a concept that is applied in the management of fisheries and forests (Chap. 4). The concepts differ in that maximum sustainable yield emphasises a purely functional use of resources. Kaitiakitanga includes a greater respect to the innate right to exist of the harvested resource and to cultural understandings of management responsibilities (Roberts et al. 1995). In this sense, while it is tempting to see parallels between Western and Māori approaches to sustainable development, the outlooks are frequently different. This has been partially recognised in the Resource Management Act (Chap. 3) which promotes adherence to 'sustainable management' and separately requires regard to kaitiakitanga.

1.5 Conclusion

This chapter has identified four reasons for being concerned about the management of New Zealand's environment. First, is the uniqueness of the environment and its status as a laboratory for studying the evolution of ecosystems because of its size, age and physical isolation from other land masses. In this sense, New Zealand may not be the world's most threatened environment, although as our later chapters will show there are significant pressures, the responsibility for retaining what remains of the natural environment is high. Second, New Zealand's environmental status is of more than ecological significance. The worldwide growth of concern with the state of the world's environment has been consciously exploited for the benefit of the New Zealand economy. Many of our key export activities, including in-bound international tourism promote New Zealand as 'clean and green'. Whether this status is justified can be debated but certainly its protection relies on demonstration of a high level of environmental responsibility. Third, new environmentalism with its concern over declining resources, increasing transparency in the environmental performance of organisations and places and increasing expectations pushes a need to pursue higher levels of environmental management. There is now widespread acceptance of the idea that economic development needs to be balanced with environmental development, at least as far as ensuring that use of the environment is adequately paid for. Four, in New Zealand environmental management must show due regard to the Treaty of Waitangi. This includes a need for active protection of the Māori interest in environmental resources and recognition that taonga to be protected include both tangible environmental resources and values such as those relating to sources of environmental knowledge.

Study Guide

End of Chapter Summary

1.1 New Zealand is a unique environment because it has evolved in relative isolation from other land masses. It is a diverse environment of multiple distinct ecosystems.
1.2 New environmentalism is distinguished by its concern for declining resources, radically more transparency in environmental performance and increased expectations.
1.3 New Zealand's claim to be 'clean and green' can be supported by some environmental indicators whilst other indicators draw attention to the risks facing the environment. New environmentalism leaves the country at risk of being viewed as not doing enough to protect its unique environmental assets.
1.4 Environmental management in New Zealand should respect Māori culture and their wish for guardianship of resources of value to them. The concept of kaitiakitanga has some similarity with sustainable resource harvesting but derives from a deep sense of responsibility toward maintaining the quality of the environment.

Discussion Questions

What are the implications of New Zealand's environmental diversity for environmental management?

Is it appropriate to seek to protect every species that remains under threat of extinction in New Zealand?

Should organisations be free to promote New Zealand as 'clean and green'?

Aside from heightened concern with declining resources, radical transparency and increasing expectations is there anything more that distinguishes a 'new environmentalism'?

Given the emergence of new environmentalism, is New Zealand better or worse positioned to maintain a clean green reputation?

How is Kaitiakitanga a concept of relevance to everyone who lives in New Zealand?

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Chapter 2
Alternative Approaches to Environmental Management

Key Questions

- What is environmental management?
- What are the main features of standards and permits, economic instruments and voluntary approaches?
- Are there clear advantages to using one type of management approach over another or does each approach have strengths and weaknesses when applied to individual management problems?
- Why is there currently much support for the use of economic instruments over other approaches to environmental management?
- How does a political economy perspective explain the choice of policy approach?
- What are the implications of a political economy perspective on policy choices for the future of economic instruments?
- Is New Zealand devoting too little attention to economic instruments?

Abstract This chapter examines the main approaches to environmental management. Command and control approaches involve standards, monitoring and enforcement of penalties by public agencies. In the last few decades it has frequently been argued that such approaches impose too many costs on both government agencies and the organisations being regulated. This has resulted in the advocacy of economic instruments which focus on an economy's overall environmental condition rather than the performance of each economic actor. Although New Zealand has introduced an emissions trading scheme it continues to be criticised by the OECD for not making sufficient use of economic instruments. Voluntary approaches to environmental management use a mix of social marketing, education, incentives and community pressure to make organisations address their environmental impacts and to help safeguard environmental resources. Two contrasting ways of explaining policy selection are: (i) normative guidance based on the understanding of the conditions in which each type of policy approach is judged most effective; (ii) a political economy perspective that examines how choices have actually been made.

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Key Concepts and Terms Command and control • Economic instruments • Environmental charges • Environmental management • Grandfathering • Green taxes • Incentive payments • Individual transferable quota (ITQ) • Labelling • Market-based instruments • Market friction reduction • Normative guidance • Offsetting • Performance-based standards • Political economy perspective • Price-based instruments • Public disclosure • Quantity-based instruments • Standards and permits • Tendering • Tradeable permits • Voluntary action

2.1 Environmental Management

The view that the environment should be managed by humans can be controversial. From an ecological perspective, the environment is best left to manage itself as natural ecosystems screen out disadvantageous components and in this sense cannot be improved upon. The assessment that nature knows best has been stated as one of the laws of ecology (Commoner 1972: 43). The concept of environmental management has greater acceptance if thought of in relation to the institutional arrangements controlling human use of the environment. Institutional arrangements refer to the 'cluster of customs, laws, or ways of behaving and organising behaviour around problems of life in society' (Kaynor and Howards 1971: 1119). These arrangements influence the forms of government, agencies, legislation and social groups that are established to guide human behaviour. In this sense, environmental management may refer to the customary practices governing the allocation of some natural resource as well as to laws and controls administered by public agencies. Awareness that some institutional context governs all human interaction with the environment permits environmental problems to be seen as institutional problems.

In New Zealand, land in public ownership and managed primarily for conservation goals provides the single most important direct protection of the natural environment (see Chap. 5 for examination of the modern day conservation estate). Liability laws making polluters liable for the damage they cause are another management tool (see Hussen 2004). Liability law relies on persons or organisations suffering environmental damage taking legal action against the perpetrators of that damage to seek financial compensation equivalent to the value of the damage experienced. Liability laws were one of the earliest forms of public policy tool to control environmental issues. They worked when environmental damage was predominantly local and involved a small number of persons but have generally become less central to environmental management as the risks of damage and the complexity of the issues have grown. Legal remedies are generally slow, costly and reactive. They rely on damaged parties having the capacity to take action and may require the coordination of a large number of affected parties. The ability to obtain compensation is also dependent upon whether polluters are held to be strictly or only partially liable for the damage they cause. Strict liability means that there is a right to compensation irrespective of whether the organisation or individual causing the damage took precautions or was aware of the potential hazard.

The threat of legal action can act as deterrence but many environmental risks require greater certainty of problems being avoided than can be given by liability law alone. The additional tools that may be employed form the focus of the discussion that follows. In particular, we look at three approaches to environmental management: (i) standards and permits; (ii) economic instruments; (iii) voluntary initiatives.

2.2 Standards and Permits

Rules and standards are the most frequent way that public agencies have managed the environment. There are broadly two types of standard: standards related to some assessment of what environmental conditions must be maintained to protect people and environments from harm, and input-based standards that specify minimum performance levels that must be attained as, for example, with acceptable car emission levels. Standard setting is often referred to as a ‘command and control’ approach for three reasons.

- Standards can identify a specific target or technology that must be adhered to. These standards may be based on local research or linked to the recommendations of international agencies such as the World Health Organisation.
- Regulation often requires that licenses or permits are issued to regulated activities to confirm that the permit holder has a right to operate whilst also outlining the limits or conditions within which operation must take place. The threat of refusal or withdrawal of the licence is one of the main ways of encouraging compliance.
- Legislation may authorise a designated authority to monitor compliance and take necessary enforcement action in cases of non-compliance with the requirements of the permit.

During the 1990s claims grew that command and control regulation is more costly and inflexible than other approaches (OECD 1994; Industry Commission 1997; Buchholz 1998). It was alleged that relying on standards gave organisations little flexibility to devise their own methods of managing environmental impacts tailored to their own situations. This encouraged resistance to accepting environmental responsibilities and a focus on ‘end-of-pipe’ solutions; that is, on cleaning up pollution after it has been produced, rather than on redesigning activities to avoid the need for end-of-pipe controls. Assuming that compliance increases when there is choice in how to meet environmental goals, shifting away from reliance on command and control could save on monitoring and enforcement costs.

Criticism of the use of standards for environmental management has been linked to an evolution in the objectives of environmental policy (Gouldson and Murphy 1998). A gradual widening of the scope of environmental policy has been observed in affluent countries (Andersen 1994). Initially, the focus is on mitigating impacts. As incomes increase, the policy focus shifts from the effect to the cause of pollution with steps to encourage treatment at source. More recently, the desire to integrate environmental management with other policy areas has grown. Addressing the cause of pollution still leaves environmental policy as a largely reactive activity, responding to the negative impacts of the economic development that virtually every other area of policy seeks to promote. Proactive environmental protection is now favoured that links environmental objectives with non environmental policy areas related to issues such as industry, energy, transport and trade (Gouldson and Murphy 1998: 7).

New policy targets arising from the desire to widen the scope of environmental management led to the identification of three gaps in command and control regulation (Haigh and Irwin 1990).

- An issue-by-issue expansion of environmental policy gives polluters scope to divert their impact to the weakest area of control rather than ensuring an absolute reduction of impacts.
- Opportunities to integrate separate regulatory systems and agencies tend to be missed, reducing the efficiency of intervention by creating policy overlaps and multiple enforcement resources.
- Policy fragmentation lends justification to the claim that legislation is confusing, sometimes establishing conflicting expectations, and hence that compliance cannot reasonably be expected.

These kinds of shortcomings played a big role in influencing the redesign of New Zealand's environmental management system during the 1990s (see next chapter). Nonetheless standards remain central to environmental management but frequently they are designed to be more flexible than those labelled 'command and control'. Regulations can set environmental goals but allow businesses to determine how best to meet those goals, using whatever methods are cheapest and most effective. New Zealand's Resource Management Act 1991, for example, is based on controlling the effects of activity but leaves it to developers to determine how they can achieve the specified performance level.

2.3 Economic Instruments

Economic or market-based instruments aim to give the greatest incentive to mitigate environmental impacts to organisations that are able to make change at least cost. If this is achieved it should mean that the environment is protected at least overall cost to society. This quality of economic instruments is frequently contrasted with regulatory approaches that seek to equalise the environmental standards adhered to across all organisations. Rather than equalising the standard attained by each individual organisation, economic instruments focus on the overall level of environmental performance for an economy as a whole and seek to equalise the expenditure regulated organisations must make for this desired level of environmental protection to be obtained. The underlying justification is that it is not necessary to force all polluters to stop polluting as long as there are some who are able to greatly reduce their environmental impacts so that pollution as a whole goes down.

Table 2.1 Three types of economic instrument for environmental management

Instrument type	Main features	Variants
Price-based	Influence decision making by imposing financial charges for environmental impacts and providing financial incentives for environmental improvements.	Environmental charges and taxes Incentive payments Tendering
Quantity-based	Set a limit to the volume of emissions or other environmental impacts and then allowing the transfer of reduction effort among the regulated organisations.	Tradeable permits Environmental offsets
Market friction reduction	Increase information availability so that consumers and producers can more fully and easily identify the environmental costs of their decisions.	Labelling Public disclosure

Table 2.2 Price-based instruments

Management tool	Example of application in New Zealand
Environmental charge	The Waste Minimisation Act 2008 introduced a $10 per tonne (excluding GST) levy on all waste sent to landfill to encourage waste minimisation and decrease waste disposal in New Zealand. Money collected by the levy funds waste minimisation initiatives and is intended to provide an economic incentive to polluters to change their behaviour.
Environmental tax	Excise taxes on petroleum fuels, motor vehicle license fees and road use charges may influence consumption behaviour, although they were not designed for this purpose and so strictly are not environmental taxes. Similarly some local authorities have 'targeted rates' to help defray programme costs (for example Environment Waikato levy for protecting Lake Taupo, community possum control and pest and weed control).
Incentive payment	The Contaminated Sites Remediation Fund: this fund was established in 1999 to allocate funds to regional councils and unitary authorities on a competitive basis. It is used to encourage investigation and remediation of land contaminated by parties on whom it is now hard to enforce liability.
Tendering	East Coast Forestry Programme (see Box 3.2)

There are three main types of economic instrument: (i) price-based (environmental charges and taxes, incentive payments and tendering); (ii) quantity-based (tradeable permits and environmental offsets) and (iii) market friction reduction (labelling and public disclosure) (Tables 2.1 and 2.2).

2.3.1 Environmental Charges and Taxes

Environment charges aim to reduce the level of environmental impact from a specific activity by levying a fee or tax per unit of that activity. The charge reduces as the level of activity goes down. In theory this means that those subject to a charge have an incentive to reduce their activity or to take mitigation measures. The strength of the incentive will be determined by the cost of taking action. So if the charge was going to be \$500, for example, there is reason to spend \$499 on avoiding the tax. On the other hand, if it was going to cost \$501 to avoid the charge a rational decision made purely on monetary calculations is to continue to cause your environment damage and pay the charge (unless higher short term costs produce long term savings).

If the purpose is to reduce environmental damage, determining the level of the charge is critical for its effectiveness. The ideal environmental charge would result in each polluter paying a charge equal to the individual incremental damage of their discharge. These are sometimes referred to as true Pigovian taxes after the economist Pigou who is credited with originating the idea. So, for example, if burning a litre of petrol to fuel a car creates \$1 of environmental damage the tax should be set at \$1 per litre of petrol. In practice precise costing of environmental damage is not possible. Nonetheless the idea inspires the use of charges but more as a means of sending a signal to polluters about society's wish for a change in behaviour than in achieving a Pigovian correction.

The terms taxes and charges are sometimes used interchangeably but taxes are strictly within the authority of central government while charges are levied by local government. This distinction has significance because generally taxes accrue to the Treasury rather than being channelled directly into a specific purpose. In New Zealand, the Treasury opposes linking tax revenue to specific expenditure purposes as it limits their ability to manage the allocation of public finance (see Parliamentary Commissioner for the Environment 2006: Appendix E). The Pigovian tax design favours centralising the revenue collected as the tax mechanism is thought to take care of the environmental issue. In this sense, redirecting revenue to ameliorate the environmental issue misses the point of the tax: if the tax is paid it means people are willing to accept the environmental damage. On the other hand, environmentalists tend to support using tax revenue to fund expenditure on the activity being taxed (Sterner 2003: 98). Linkage gives certainty that efforts are made to address the issue and can help to substantiate a 'green' purpose for the tax and deflect accusations that it is simply another revenue source for government expenditure.

As noted, in the pure sense environmental taxes have proved impractical as understanding of the costs of environmental damage and the cost of mitigating environmental impacts are too complex to identify. In their place, taxes and charges have been levied that may still seek to send a strong economic incentive to invest in environmental measures. Even then practical issues remain that are challenge to relying on this form of environmental management.

- Organisations face a double financial burden if they are to address their environmental impacts. For individual organisations, taxes are highest while their environmental mitigation costs are highest as large amounts of environmental impact imply large investment in remedial measures. Consequently the timing of charges can affect the ability or at least willingness to invest in improvement. Dropping taxes in return for substantial abatement expenditure or levying a tax only on impacts above a specified level are possible ways of reducing this dilemma.

Modifications imply the need for regulatory administration, highlighting how charges can be used in conjunction but not in place of ‘command and control’.

- Setting the level of the tax or charge is a significant challenge if the intention is to encourage a significant reduction in environmental damage. ‘Trial and error’ may be the only option, adjusting the tax according to observed changes in environmental impact. A challenge is that abatement measures may involve large investments with large impacts rather than small adjustments that respond to incremental tax adjustments. Alternatives are to base the charge or tax on a measurable input that has some relationship with the environmental impact (for example using fertiliser applied by farmers as a proxy for the impact of farming on the nutrient loading of waterways) or to base it on the cost of abatement.
- Charges may not give sufficient control where it is important to keep environmental impacts within a critical threshold. The uncertainty of what, if any reduction in damaging activity is produced by a charge means that there is insufficient control. Taxes and charges are practical where it is sufficient merely to signal that there are environmental costs rather than to attain a precise level of control.

Payments for domestic waste disposal are frequently seen as a successful example of environmental charges. These have replaced or supplemented the reliance on fixed collection fees and are now widely used in New Zealand (Parliamentary Commissioner for the Environment 2006). Programmes take various forms such as prepaid rubbish bags, prepaid stickers to be attached to bags or other wastes for collection or some combination of a fixed fee and then additional charges for extra disposal. Reduced volumes of household waste are typically collected when charges are made, often helped by the introduction of free recycling programmes for glass, paper, plastics and other materials that offer a way of minimising payment. Acceptance is also to some degree helped by dumping, burning or placing waste in public or private collection containers so as to avoid the full cost of waste disposal.

2.3.2 Incentive Payments

A variant on levying a charge is to offer some form of incentive payment such as through a subsidy or tax rebate scheme. An example may be reducing the amount of some tax or fee that an individual is required to pay in exchange for undertaking an activity that benefits the environment. There are a number of general circumstances where it may be thought appropriate to give financial incentives for desired actions as an alternative to charging for environmental damage.

- In cases where the person or organisations responsible for the environmental damage cannot be identified or located. This may arise where the problem arises from historical activity or from a polluter that is unidentifiable, bankrupt or non-existent. In these circumstances the government may have little choice either to finance improvement directly or subsidise others to do the clean up.

- In cases where improvement has benefit for the community as a whole that the investor cannot themselves gain from. Charging a polluter for their environmental impact may bring a change in behaviour where the polluter as well as the wider community stands to gain from reducing the damaging activity. The ability to benefit from an enhanced business reputation or from a more efficient use of resources provides incentives to improve performance in addition to the direct incentive of avoiding a charge. This is the idea that pollution prevention pays. Where the benefits of environmental mitigation are diffuse and mainly captured by society at large the case for a subsidy rather than a charge increases.

Deposit-refund schemes that combine a charge (paid as a refundable deposit) and a subsidy (the payment given on return) are a variant of the financial incentive approach. The deposit-refund approach makes polluters pay a charge by not having their deposit refunded. This mechanism gives deposit-refund schemes a high degree of self management as there is no need to monitor compliance to the extent that refunds are only paid when compliance is demonstrated through the return of the item that carries the refund. Despite this advantage, the use of this approach is well established only in the case of beverage containers and less frequently with other small items such as car batteries. Sweden has instituted a deposit-refund scheme for motor vehicles to control the dumping of scrapped vehicles. The deposit was successful in getting a car's last owners to return their cars but it did not provide an incentive for modifying motor vehicles to increase the scope for recycling and product improvement (Lindhqvist 2000: 88). For these reasons the scheme was replaced by a more ambitious product stewardship scheme in 1997 that required manufacturers and importers of cars registered after the scheme's introduction to accept end-of-life vehicles free-of-charge. Built into the scheme are targets for the proportion of materials in vehicles that can be reused or recycled

Incentives to remove an environmental damage can be more appropriate than charging for damage when dealing with the legacy of past action. The danger of incentive payments is that they may be paid when not required and that they may encourage subversion. Both issues arise with deposit-refund schemes.

Deposit-refund schemes are used for drink containers (bottles and cans) in many countries but not for paper. Where schemes operate, recovery rates for drink containers can be as high as 98% for glass bottles. Interestingly the recovery rate does not seem to be sensitive to the size of the refund (Sterner 2003: 365). Indeed, voluntary recycling schemes for glass, plastics and paper can also achieve high rates of recovery. This suggests the importance of information, opinion, values and habits in encouraging the participation in recycling rather than the financial incentive. Of particular importance is the ease of being able to fit recycling into everyday activity without the need for special journeys or adherence to specific collection schedules. Even long distance travel need not be a barrier provided that it can be integrated with other routine activity.

The extension of deposit-refund schemes to more valuable or pollution intensive items needs to be accompanied by administrative systems to prevent abuse. Rogue imports from other countries for the sole purpose of collecting refunds need to be screened out.

2.3.3 Tendering

Tendering is a way of distributing a subsidy to recipients who commit to engage in activities to improve the environment. Tenders administered by public agencies call for bids to undertake work of a specified nature that will be paid for by the organising agency. Tenders describe the work that will be undertaken, the likely benefits and the budget required to complete the work (MacDonald et al. 2004). This allows the agency to allocate their funds according to cost per unit of environmental benefit that it is claimed will be obtained. Tenders are ranked and accepted in order of cost per unit of environmental benefit offered until the budget is exhausted or until the benefits projected fall below a threshold judged worthy of support. It aims to concentrate funding in a way that obtains a higher level of environmental improvement effort than would be obtained by supporting activity through a standard funding rate.

Research on potential impact of tendering suggests that most benefit is obtained within the first few tender rounds (MacDonald et al. 2004). After the initial allocation of funds, the least cost projects tend to have been completed and the most costly projects screened out. Subsequent tenders tend to vary comparatively little in their costs and benefits once the extremes have been excluded. Moreover, later tenders are informed by previous funding decisions and use this knowledge as a guide to formulating proposals. In other words the tendering approach is helpful in ensuring that the 'low hanging fruit' are harvested first but less effective in ensuring cost savings are sustained (Box 2.1).

Box 2.1 Case Study: Tendering the East Coast Forestry Programme (Source: Bayfield and Meister 2005)

The East Coast Forestry Project started in 1992 with the objective of planting 200,000 ha of commercial forest over 28 years on severely eroding and potentially erodible land in the East Coast of the North Island. This target was scaled back to 60,000 ha of the most at risk lands plus immediate surrounding areas. By 2006, around 32,000 ha had been planted and a further 5,000 ha had been approved for planting over the next few years.

Under the project, landholders tender for government grants which help fund the cost of establishing and managing the forest. This financial assistance offsets the additional costs and risks associated with planting trees on fragile land. Tenders are prioritised based on a ranking that utilises a land classification weighting system that seeks to identify areas where erosion is worst. A tender application covering low erosion-risk land is more likely to be rejected than one covering land of high risk.

With planting well short of the target set few tenders were being rejected. Declining interest in commercial forestry led a programme review in 2005 to

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Box 2.1 (continued)

conclude that tendering was of declining effectiveness. With significant erosion problems remaining, it was recommended that the scheme be changed to the allocation of grants through negotiations with individual owners of the land most in need of erosion control.

Critical thinking question: Based on the experience of the East Coast Forestry Programme, what conditions are required for a voluntary tendering scheme to be an effective method of environmental management?

Table 2.3 Quantity-based instruments

Management tool	Example of application in New Zealand
Tradeable permits – individual rights are allocated, as in the form of an allowable level of emissions that set a limit on activity that can be exceeded if additional entitlement is purchased from others not using all their entitlement.	The New Zealand Emissions Trading Scheme aims to reduce greenhouse gas emissions by promoting trade in the right to emit 1 tonne of carbon dioxide, or equivalent amounts of certain other greenhouse gases. Under the scheme some organisations are required to surrender NZUs (New Zealand Units, the currency of the scheme) to the Government (for example, petroleum companies that mine fuels that emit carbon when used); some earn NZUs (for example, forest owners) and some are given NZUs to protect them from increases in energy costs that they cannot absorb or pass on to customers (judged by tests for trade exposure and emissions intensity). Trading occurs as those with spare NZUs sell them to those who have to surrender NZUs.
Environmental offsets – actions taken that neutralise the impact of other actions having adverse environmental impacts.	The New Zealand Emissions Trading Scheme allows greenhouse gas emissions from agriculture to be offset in various ways including tree planting, use of nitrification inhibitors or improvements in the energy efficiency of farm operations.

2.3.4 Tradeable Permits

Tradeable permits are a quantity-based economic instrument (Table 2.3). They involve the setting of some form of quantitative target and then use economic incentives to obtain compliance to that standard. This means that they are not wholly reliant on market processes as there is a need for regulation that sets the context in which economic incentives are allowed to influence mitigation effort. Nonetheless because they can reduce some of the uncertainties associated with price-based instruments they have attracted a great deal of attention.

The theory behind tradeable or transferable permits is that they achieve the same cost minimising allocation of the regulatory burden as a charge system while avoiding the need to be concerned with how individual organisations will respond to the incentives that are introduced. As noted above, the difficulty of identifying the deterrent effect of taxes and charges is a limitation of their use. Firms may absorb them as a necessary cost rather than be stimulated to increase their mitigation effort. Under a tradeable permit scheme, an allowable overall level of pollution is established and allocated among firms in the form of permits. Organisations that keep their environmental impacts below their allotted level may sell their surplus permits to other firms or use them to offset impacts generated by other parts of their organisation that are beyond the permitted level.

The permit approach can be applied to pollution control problems as well as to the allocation of an environmental resource among users where the resulting instrument is typically known as an individual transferable quota (ITQ). Indeed the use of ITQ's to manage inshore fisheries is one of the main examples of tradeable permits being used in New Zealand. The scheme was introduced in 1986 as a response to the depletion of fish stocks and estimates that the full time inshore fishing fleet was almost double the size of that justified by the size of the fishery (see Chap. 7).

Whatever the form taken, tradeable permits in effect allocate ownership rights to some aspect of the environment. These rights either give a share of the assimilative capacity of the environment such as the right to emit pollutants into the atmosphere or, in the case of transferable quota, a right to use a share of an ecosystem such as a fishery. Trading of the ownership rights facilitates economic change (businesses gain an additional incentive to introduce more environmentally friendly methods) and allows new businesses into a sector controlled by the trading scheme (provided there are permits to buy). Transferability gives opportunity for those who do not need to use all their permit entitlements to sell them to others. This potential income source is intended to encourage businesses to give more attention to their environmental impacts and to search for innovative, low cost ways of reducing them. Or in the case of transferable quota schemes, an incentive is given to protect and enhance the resource as this should be reflected in the value of the quota rights.

Tradeable permits differ from charges in the setting of an initial total limit on the emissions or resource demands and in the distribution of the revenue obtained. In a charging system, the revenue is collected by the agency managing the scheme and may or may not be reallocated to addressing the environmental issue. With tradeable permits, revenue goes directly to organisations that minimise their pollution (provided surplus permits are sold) and the extent of competition for permits determines how much is paid and the extent to which payment encourages environmental management.

The initial allocation of permits and quota has further important impacts on the distribution of the economic burden. The government agency designing the scheme must decide whether permits are distributed:

- according to historic emissions or past use of the resource (the grandfathering principle)
- equally among the potential users;
- in proportion to the size of the organisations;
- by a lottery that allocates entitlements at random;
- by an auction according to the highest bids obtained.

The grandfathering principle has been the most frequent method for allocating permits. It is the easiest approach to follow as it endorses the status quo but this tends to favour the existing major polluters or largest resource users while creating a barrier for new entrants who must purchase permits from existing holders who received them free of charge. Allocating pollution permits free of charge also has wider implications that some economists suggest can affect the extent to which society as a whole benefits from environmental improvement (Parry 2002).

However regulation is designed, wherever it effects goods or services used by most households the costs tend to be born disproportionately by those with the lowest incomes. This outcome can be exaggerated by the grandfathering of permits as it tends to consolidate the position of large incumbents by giving them an asset that increases their net worth. In turn, this transmits an economic benefit to shareholders in the companies that receive permits free-of-charge. Where utility companies are owned by the state this increased value can be redistributed to the community. Where utility companies are privately owned a redistribution of wealth can occur. Shareholders, including those who directly hold shares and those with pension savings invested in shares, are typically comparatively wealthy. Consequently, a study in the USA that assumed carbon emission permits to secure a 15% carbon reduction were grandfathered found that:

- the annual real spending power of the lowest income quintile would reduce by US $530;
- the annual real spending power of the highest income quintile would increase by US $1,810 (Congressional Budget Office 2000).

Auctioning permits can generate revenue that government can redistribute to low income households. Mixing grandfathering and auctioning is possible too and may be attractive if used to allow the volume of permits to be adjusted according to evidence about the impact of an initial allocation of permits (Goulder 2000). Nonetheless, governments often find it easier to grandfather all permits as this can generate least political risk.

The responsibility to recognise customary resource entitlements and to protect communities with a particular association with a resource may also need to be considered in the allocation of permits. This consideration is especially important in New Zealand where access to environmental resources is governed by the Treaty of Waitangi (Box 2.2). Partly recognizing cultural differences, critical perspectives on tradeable permit schemes raise questions about the approach to addressing environmental problems through monetary valuation and markets alone (Corbera and Brown 2010).

A good understanding of the costs of abatement is required for tradable permit schemes to work effectively. This makes it a challenge to introduce permit schemes to manage a previously unregulated issue, but this is typically where they have been tried. Prior experience of managing an environmental issue helps give insight to ensure that the right volume of emission permits are allocated and that there will be sufficient incentive for permit trading to occur. If it proves to be the case that many sources can easily obtain large amounts of emission rights, then incentives for

Box 2.2 Discussion Point: Māori Fishing Rights and the Individual Transferable Quota (ITG) Scheme (Source: James 1996; Batstone and Sharp 1999; Sinner and Fenemor 2005a)

The ITQ scheme was introduced with the assumption that because quota was to be allocated according to historic catch levels there was no particular implication for Māori. The 1985 Muriwhenua claim lodged with the Waitangi Tribunal argued that the ITQ scheme breached the Treaty of Waitangi. Māori fishing interests were guaranteed under the Treaty and reaffirmed in the 1983 Fisheries Act which stated 'nothing in this Act shall affect any Māori fishing right'. The Waitangi Tribunal failed to delay introduction of the ITQ but it held up extension of its coverage pending the release of the Tribunal decision. The Waitangi Tribunal Muriwhenua report concluded among its findings that:

> The quota management system, as currently applied, is in fundamental conflict with the Treaty's principles and terms, portioning to non Māori the full, exclusive and undisturbed possession of the property in fishing that to Māori was guaranteed; but the quota management system need not be in conflict with the Treaty, and may be beneficial to both parties, if an agreement or arrangement can be reached (Tribunal 1988: 11.5(r)).

An interim settlement enacted in the Māori Fisheries Act 1989 saw government purchase and give to Māori 10% of all fishing quota. The Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 transferred around a quarter of the then allocated quota to Māori and a promised 20% of all new quota. A Treaty of Waitangi Fisheries Commission (Te Ohu Kaimoana) was established to manage the quota prior to its distribution to individual iwi and to support Māori participation in the industry. The Māori Fisheries Act 2004 established the mechanism through which the allocation to iwi has occurred. The settlement also recognised the importance to Māori of non commercial customary food gathering. Taiapure provisions of the Māori Fisheries Act 1989 (reaffirmed in the Fisheries Act 1996) and the provision for maitaitai reserves of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 recognise a Māori management role and Māori food gathering interests.

In 2006, a Ministry of Fisheries discussion document on 'shared fisheries' reignited Māori concerns. Some Māori questioned the possibility of commercial quota being taken back for allocation to recreational fishers (a category including commercial tourist operators who take paying customers on fishing trips).

Critical thinking question: What lessons for the introduction of tradeable permits do you think should be taken from the fisheries experience?

abatement at other sources are reduced. Some experimentation and policy adjustment must often take place to improve the effectiveness of emission trading. Even then the success of trading schemes can depend on changes going on alongside the trading of permits rather than the trading scheme itself (Box 2.3).

Emission trading schemes can be too uncertain when environmental issues need close control (Sterner 2003). There must be a relatively high level of knowledge about the environmental issue being managed and a degree of stability in the influences on the environmental outcomes. For example, if environmental risks

Box 2.3 Discussion Point: Does Sulphur Dioxide Trading Prove the Case for Tradeable Permits?

The control of sulphur dioxide (SO_2) emissions associated with power generation in the USA is frequently referred to as a successful use of tradeable permits for managing a large scale, long term environmental programme (Sterner 2003; Hussen 2004). Responding to a growing acid rain problem, the SO_2 emissions reduction programme was introduced in 1995. It aimed to cut the annual SO_2 emissions from power plants by 10 million tons by the year 2000 under phase one and by a similar amount in phase two running from 2000 to 2010. The scheme set a cap and allocated permits to this emission level and then required individual power companies to hold sufficient permits for their SO_2 emissions. Trading was unrestricted allowing environmentalists (who might wish to accelerate abatement by holding but not using permits) and investors speculating on the future price of permits to participate. Other sources of SO_2 were excluded to avoid mixing activities with different abatement issues and costs. As well the scheme allowed for offsets, bubbles and banking (all mechanisms designed to avoid making it too difficult to comply).

Phase one targets were achieved at a compliance cost below that anticipated. Nonetheless how much of the success in reducing SO_2 emissions can be attributed to permit trading as compared with other conditions working in favour of cutbacks is unclear.

- The cost of abatement technology fell significantly after the programme started, particularly in the reduced price of air scrubbers.
- The programme coincided with the deregulation of the rail industry that decreased the cost of freight and increased the attractiveness of purchasing coal with low sulphur content.
- Some states introduced local environmental regulations that added to the pressure on power plants to cut emissions.

Critical thinking question: Does the SO_2 emissions trading programme prove the case for tradeable permits?

were to change in an unanticipated way the volume of permits allocated might give insufficient control. The difficulty of responding to any such instability arises because permits must be viewed as permanent and reliable if they are to influence business decisions. One response to this is to allow the total number of permits to vary depending on ecological or other conditions. This approach has been followed with fisheries management where tradeable harvest quotas for fish are formulated as shares of a total allowable catch that is set according to the most recent fish population data. This flexibility is accepted as there is widespread acceptance that the dynamics of the ecosystem are difficult to predict much into the future. In other cases where there is a need for close management, as where environmental risks are high or technological opportunities are changing, permits have operated as part of a short term adjustment scheme where the limited life of permits was signposted at the outset.

Trading systems work better as the number of parties involved in the exchange of permits increases and there is a large variation in the costs of mitigating environmental impacts among the parties. As well, the system for agreeing and registering trades of the permits needs to be simple as high transaction costs are a deterrent to trade. Recipients of permits must be willing to buy and sell permits if the environmental compliance effort is to be redistributed away from organisations facing the highest costs of making improvement. In industries with only a small number of participants, individual permit holders may be motivated to hoard them strategically as a way of making life hard for competitors.

The use of tradeable permits is difficult where localised pollution hot spots need to be controlled. Trading schemes have least risk where the environmental impacts are diffused over a wide area rather than being concentrated according to local conditions and the concentrations of emissions. This requirement is in tension with the previous point. The scheme must cover a large enough population to allow trading between polluters with varying costs of abatement if there are going to be cost savings in securing compliance to the total emission level. On the other hand, if the population occupies a geographical region comprising many different types of environment there is a likely to be a need to manage individual risks as well as the overall level of emissions.

New Zealand's ITQ scheme for fisheries can be credited with helping prevent the collapse of the fishing industry but the wider long term impact remains open to investigation (see Chap. 7). New Zealand's emissions trading scheme for greenhouse gases (discussed further in Chap. 8) shows the challenges in this policy approach when there is no feasible way for emissions to be reduced other than by reducing economic activity (Box 2.4). The OECD (2011: 155) says the scheme is a 'solid basis upon which to build an efficient, fair and effective carbon pricing scheme' but notes that 'the broader social acceptability and political durability of this highly complex financial scheme and major economic reform will be an ongoing challenge'. The Parliamentary Commissioner for the Environment has warned that by allocating too many free emission entitlements the scheme is in danger of replicating the initial experience of the ITQ which also was too generous in its initial allocation (Wright 2011: 5).

Box 2.4 Discussion Point: Was New Zealand Ready for Emission Trading?

The Climate Change Response (Moderated Emissions Trading) Amendment Act 2009 reaffirmed that the existing emissions trading scheme (ETS) would continue to be introduced. Deemed too onerous by a newly-elected National-led government, the forestry sector only was covered by the scheme while it was reconsidered. A Select Committee Review concluded that a carbon trading scheme covering all economic sectors was preferable to a carbon tax which was the main alternative policy considered. The amending legislation aimed to ease the economic cost of emission trading in several ways.

- A price of $25 was fixed for Government-issued NZETS allowances (New Zealand Units, NZUs) used for compliance purposes during 2010–2012.
- Stationary energy, industrial process and liquid fuel installations (the first sectors to join after forestry) need to surrender only 0.5 NZU for each tonne of carbon emitted.
- During a transition period (2010–2012) there is an unlimited supply of emissions allowances and so no overall cap on emissions.
- Emissions-intensive industries exposed to international trade will receive the bulk of their allocation without cost. These will be allocated on an intensity basis meaning that there is no penalty if total emissions increase providing that emissions per unit of output do not increase.
- The phasing out of free emissions allocations starts in 2013 (2016) for agriculture at a rate of 1.3% a year.
- The entry of sectors is sequenced according to the capacity to cut emissions without damaging their competitiveness in the international market place. Agriculture will not enter the scheme until 2015.
- Prior to full implementation, the scheme would be kept under review to ensure that it continued to be justified, give opportunity for modification and to ensure it matched with schemes expected to be introduced overseas.

The perceived need to ease the introduction of the ETS is partly a response to the concentration of New Zealand's greenhouse gas emissions from agricultural activity for which there are presently no alternative production methods that offer ways of substantially reducing emissions. The Pastoral Greenhouse Gas Research Consortium (PGgRe) is supported by major rural industry agencies to coordinate industry-wide research into agricultural emissions and their reduction. Its goal is a 10% reduction in greenhouse gas emissions across the agricultural sector by 2013 relative to 2004. This compares with New Zealand's international commitment reiterated under the Copenhagen Accord (2009) to reduce emissions by 10% below 1990 levels by 2020 or, if a comprehensive global agreement is reached, by 20%. Promising innovation to reduce emissions through the pasture application of nitrification inhibitors is claimed as well as the potential for soil carbon sequestration. On a larger scale, New Zealand in

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Box 2.4 (continued)

2009 announced the formation of a Global Alliance on Agricultural Greenhouse Gas Mitigation to bring interested countries together to drive greater international cooperation, collaboration and investment in this area of research.

Immediately, offsetting is the main option for addressing agricultural emissions short of production cutbacks or radical changes in farming techniques (such as housing cattle in sheds). In New Zealand, plantation forestry offsets about one-third of New Zealand's non-forestry greenhouse gas emissions but by 2020 Forestry is expected to become a net source of emissions due to the harvesting of forests planted in the 1990s.

Critical thinking question: Is an emissions trading programme the best option for controlling emissions from farming? What other mechanisms would you recommend to assist agriculture reduce its greenhouse gas emissions?

Nutrient trading to manage the flow of farm affluent into Lake Taupo, the southern hemisphere's largest lake is New Zealand's other main experience with tradeable permit schemes. As discussed in Chap. 6, this scheme has required several interventions to gain acceptance including establishment of a management agency that has brought in additional financial resources to get the scheme established (OECD 2011: 143).

2.3.5 Environmental Offsets

Offsets can be incorporated with a tradeable permit scheme as well as being a management approach in their own right. The basic idea is to facilitate development that has undesired environmental costs by allowing it to be offset by other investment that has compensating outcomes. This offers a compromise to the proponents and opponents of new economic activity that has environmental consequences. When offsets work as intended they at least ensure that the total stock of environmental capital is not diminished even if some localised areas affected by development are degraded. Nonetheless because of the uncertainty that an offset compensates sufficiently for the impacts of new development they should be viewed as a measure of last resort used only when impacts cannot be reduced at source or development avoided (Landry et al. 2005; Pearce and Warford 1993).

Offsets may be negotiated directly between a developer and an owner of a potential offset site or they might be managed by a private or public offset bank. An offset bank is a register of completed projects that have been assessed for their environmental values with these credits available for on-sale to a developer. The offset can include a trading ratio whereby credits exceed estimated impacts. This can be presented as an opportunity to secure a net environmental gain although it can also be viewed as a margin for uncertainty and difference in the precise environmental qualities of the matched projects.

The use of offsets has grown in association with the management of greenhouse gas emissions to curb climate change (Kollmuss et al. 2008). It is desirable that individuals and organisations lower their emissions primarily by improving energy efficiency, converting to lower emission alternatives or changing their consumption patterns. These options exist for most business activities. Offsets have become part of carbon management because the general view has been accepted that the geographical location of a mitigation measure is irrelevant to its effect on global warming. This has encouraged the acceptance of offsetting to reduce the cost of meeting reduction targets as well as to accommodate those activities which have limited means to reduce their emissions short of ceasing activity entirely (Corbera and Brown 2010).

Geographical separation of the activity seeking an emission offset and the offset project heightens the need for enforcement of rules to ensure the legitimacy of offsets. Additionality is a basic requirement of all offsets but it is raising particular issues in the context of carbon management (Kollmuss et al. 2008). Additionality refers to the requirement that the reductions in emissions arising from the offset would not have otherwise occurred. This is necessary to substantiate that someone or some organisation somewhere has reduced an equivalent volume of emissions as those that are being offset. The problems is that many of the projects being presented as offsets might have occurred under normal circumstances such as the way that changes in household income tend to bring a shift in consumption patterns or that new investment tends to be more energy efficient than the investment it replaces.

A range of either project-based or performance standard tests can be selected from to ensure that each offset is judged appropriately but in practice administrative simplicity and the reliability of the test employed are considered (Kollmuss et al. 2008). Project-based tests offer a variety of ways of judging whether individual offset projects might have progressed without the need for the emissions saving but all tend ultimately to rely on a subjective assessment of the motivations for the offset. For example, an investment test assumes that an offset project is additional if it would have a lower than acceptable rate of return without revenue from the sale of carbon offsets. Use of this test ideally means knowing what the actual rate of return achieved is and what return would normally be required. Performance standards avoid the need for case-by-case evaluations by specifying thresholds for technologies or projects to determine additionality. In this approach any use of a particular type of equipment or any project below a baseline level of emissions occurring in specified places might be taken to indicate sufficient deviation from the ‘business as usual’ situation to be considered additional.

Difficulties can be reduced by employing a mix of methods to judge additionality and by adding a margin to take account of the possibility that a proportion of the offsets may have occurred without any additional incentive. A further measure is to require offsets to demonstrate environmental benefits beyond the focal issue.

The offset or ‘flexible mechanisms’ introduced by the Kyoto Protocol (see Chap. 8) are now among the most widely investigated as well as most extensively utilised offset programmes. These offsets take the form of Joint Implementation (JI) and the Clean Development Mechanism (CDM). They were allowed to reduce the cost of complying with the greenhouse gas emission targets that signatories to the Kyoto Protocol agreed to make (technically referred to as Annex 1 countries). A further justification is that they may help bring larger environmental gains for low income countries since the two forms of offset mainly involve high income countries investing in projects located in low income countries.

The CDM is the most important of the two mechanisms and has been presented as a particularly high quality form of offset (sometimes referred to as a 'gourmet offset') on account of its procedures for establishing additionality, project registration and monitoring and its expectation that offset projects simultaneously have strong social and environmental benefits. As the projects must be implemented in developing countries the CDM is seen as a way of encouraging voluntary participation in efforts to reduce greenhouse gases in return for payments from developed countries who in turn benefit from the reduce cost of meeting emission reduction targets (Boyd et al. 2009). Nonetheless doubts have grown as to whether the overall consequences of the CDM are positive for the environment. Kollmuss et al. (2008: 89–90) identify six main shortcomings.

- The relative impact of a tonne of carbon emitted is the same whatever the source location but this does not mean that offsetting is a perfect substitute for cutbacks directly in industrialised nations. Differing reductions may have varying long term impacts depending on how they are achieved. For example, reductions made by switching between fuel types might be lost if the relative prices of fuels turns against the one with lowest carbon content. In contrast a project based on facilitating a switch from private to public transport may have long term impacts in assisting a transition to a low-carbon economy. Offsetting through the CDM may be reducing the pressure to search for emissions savings through projects of enduring importance and that bring positive multiplier affects beyond the immediate carbon savings.
- Encouraging offsets can bring barriers to the future regulation of emission sources. Beneficiaries from the sale of carbon credits may oppose regulation that would deny them that revenue.
- The emissions that would have occurred if the market for offsets did not exist must be estimated in order to calculate the quantity of emissions reductions that the project achieves. Additionality testing is imperfect as the true counterfactual situation that would exist without the offset project cannot be known for sure.
- The CDM as with other offset markets are subject to 'moral hazard'. In 'normal' markets the interests of the buyer and seller tend to work in opposite directions whereas in an offset market both the buyer and seller benefit from maximising the number of offsets a project generates. Tight regulation and ongoing monitoring is needed in the administration of offset schemes. In 2010 it took an average 572 days for a CDM project to go through validation and registration and another 607 days until first issuance (Kossoy and Ambrosi 2010: 47).
- Maintaining the independence and neutrality of the auditors who verify emission reductions has proved a much greater challenge than anticipated. Auditors must

balance their business interest in maintaining relationships with project proponents against the reliability of their audits.
- The offset co-benefits to host countries from CDM projects have been limited especially in the extent of their impact on poor communities without access to energy services. In the context of forestry projects, it has been observed that they have typically been driven from the top down and not well integrated into the priorities of communities where they occur (Boyd 2009).

These doubts can be appreciated when examining the most popular forms of project that have occurred under the CDM (Table 2.3) Writing in the context of the environmental challenges to New Zealand's food exports, it has been suggested that offsetting has lost some credibility in the UK because it is seen as dodging the problem and because some schemes have been shown to be spurious and verging on fraudulent (Saunders and Barber 2008: 87). These concerns have been fuelled by the growth of voluntary carbon offsetting (as compared with offsetting linked to the Kyoto protocol) where the testing of additionality and other attributes has been comparatively weak (Corbera et al. 2009). This experience echoes an earlier assessment that offsets are more popular with developers than green groups because of concerns that offset projects are frequently of lesser environmental quality than the environments lost to development (MacDonald et al. 2004). Uncertainty over the environmental merits of offsets suggests the need for a government agency to solicit and monitor offset projects and this implies a significant administrative cost will be required at least until there is a high level of confidence in the idea of offsets.

2.3.6 Labelling and Public Disclosure

A third type of economic instrument aims to inform decision makers about the environmental performance of producers and products. These can be regarded as an economic instrument as market mechanisms assume that decision makers are well informed about the costs and benefits of their decisions. In this sense market friction is reduced by requiring or encouraging the disclosure of information. Information disclosure has been seen as the 'third wave' of environmental policy making (after command and control and market-based instruments) because it is thought that many environmental problems can be reduced if there is awareness of the full costs of goods and services and because the costs of providing, processing and disseminating relevant information have been changing (Tietenberg 1998). Programmes have been of two main types:

- labelling;
- public disclosure or reporting schemes.

Labelling requirements can improve the information available to consumers. Product or eco label schemes allow the use of a licensed logo on products that have passed pre-set environmental performance criteria. Following the introduction of the Blue Angel mark in Germany in 1977, such labelling schemes have been introduced in most OECD countries. Certification is generally based on a life cycle assessment of the product's impact on the environment from design to disposal. These schemes partly came about in response to the growth of 'green advertising' where producers made unsubstantiated claims about the environmental performance of their goods. Labels aim to provide some certainty and standardisation to the claim of being 'good for the environment'.

At times industry and environmental groups have been critical of labelling schemes (Eden 1996; West 1995). Business groups have expressed concern with the proliferation of schemes and potential use as an impediment to international trade. Environmental groups tend to oppose voluntary schemes as this simply encourages their use as promotional tools and brings no direct stigma on companies failing to meet the scheme's standards. Questions are also asked about the method for identifying products to endorse. The favoured approach is to use a reduced or streamlined form of life cycle analysis. Even where the analysis is comparatively rigorous results are too generalised and simplified to encompass the variability of environments in which individual products are used and disposed of (Box 2.5).

Interest in labelling programmes appears to have peaked. In most countries, product labelling schemes have remained confined to a few product areas such as detergents and toiletry items. The regulatory efficiency of labelling schemes versus other tools remains largely unexplored (Stavins 2003). A study of energy efficiency labelling suggests that such labels are effective in making consumers more sensitive to energy price changes than otherwise they would be (Newell et al. 1999).

Box 2.5 Discussion Point: Life Cycle Assessment (Source: Arnold 1995)

Life Cycle Assessment (LCA) aims to identify environmental impacts associated with the creation, use and disposal of a product. The value and credibility of any LCA depends on the quality of data on which it is based. An accurate LCA requires that direct as well as indirect impacts are measured. This is not easy. Impacts of the same product or process will vary according to the environmental and regulatory conditions encountered. The importance and severity of environmental impacts often depends upon local conditions which vary within and between countries and which can change over time. One option is to use standardised impact data for an average product made/disposed in an average environment, but such approximation can make LCA results unreliable. Moreover the output of a LCA is merely a recommendation of the least environmentally damaging option. The recommended option may still result in serious impacts on the environment through the cumulative effects of mass consumption.

Critical thinking question: How far do you think LCA is capable of providing better information than the traditional environmental policy approach of seeking each agent in the lifecycle to focus on minimising their own direct impacts?

The perceived success of energy performance labelling has led to a joint New Zealand-Australia Equipment Energy Efficiency (E3) Programme that since 2006 has been developing mandatory energy efficiency labels and performance standards for a range of commonly used electrical residential, commercial and industrial products. New Zealand also encourages voluntary product endorsement through the ‘energy star’ scheme that was first developed by the United States Department of Energy to encourage consumers to purchase more efficient products.

The diffusion of labelling reflects conditions prevailing within industries such as the ease of satisfying criteria, the degree of consumer awareness and interest in and the ease of getting business support for a label scheme (Nadaï 1999). Depending on the balance of these influences, business populations attached to individual industries have been identified as responding in different ways.

- Cooperation as arisen where industry participants perceive that addressing an environmental challenge is supportive of the industry’s preferred technology. This can be because the environmental concerns are focussed on one aspect of the industry’s product rather than fundamentally challenging current business practice. Nadaï (1999) identified this context in the case of the paint and varnish industry. Environmental concerns focussed on the reduction of volatile organic compounds. Industry was willing to accommodate this issue as it posed no threat to their own strategy of differentiating water and oil-based paints.
- Resistance to an eco label has arisen where industry participants share a common view that labelling criteria would be hard to achieve and of limited interest to consumers. The manufacture of hairsprays was identified as fitting this situation.
- Industry division is a third possible response where some businesses align themselves to a labelling scheme and others stay outside. The laundry detergent industry was identified as an example with businesses differentiated according to their assessment of the marketing potential of ‘green’ detergent.

Public disclosure differs from labelling in that the information released relates to the actual use of environmental resources or specific environmental impacts or both. This gives the public ‘raw data’ about an organisation rather than labelling schemes which offer a third party judgement about a product or organisation. There are three justifications for seeking public disclosure, each of which suggests a potential set of benefits (Stephan 2002; Beierle 2003).

- Normative: the public has a ‘right to know’ to facilitate taking action to reduce impacts on themselves and the community to which they belong.
- Substantive: the release of data has the potential to produce new insights and understanding of environmental problems and how to remedy them. This may occur internally within the organisations disclosing information as the process for collecting data encourages thinking about processes for reducing adverse impacts. Externally, sharing information with government agencies may enable the better design of public programmes for example by understanding where to focus improvement efforts.

- Instrumental: disclosure will ‘shock and shame’ poor performers into taking action. The release of risk and impact data shocks citizens, the media, agencies and markets who become external sources of pressure on organisations. In turn, companies feel a sense of shame that drives them to initiate change.

The normative case can be seen as an aspect of an open, democratic society but two considerations may limit how far the public benefits from a ‘right-to-know’. First, appropriate reaction to environmental data can depend on a high level of understanding and an absence of manipulation by groups with an interest in promoting a particular interpretation. Second, there may be a concern that the information is used for the purpose intended. Public disclosure programmes generally have a particular public in mind when encouraging information release such as those residing within a particular administrative area or in proximity to a source of pollution. In practice it can be difficult to restrict access to publicly disclosed information or the purpose to which it is put. An extreme possibility, for example, is that information on toxic chemicals or radioactive substances directs terrorists to potential targets or bomb making materials. As well as these two concerns, the cost of collecting and reporting information may be a concern. Allowing the use of proxy measures (for example allowing emissions to be inferred from the volume of inputs utilised) can reduce costs but lessen the reliability of the data.

As noted in Chap. 1, the Toxic Release Inventory (TRI) in the USA is the most recognised and influential information disclosure programme used by environmental managers. Although referred to widely as evidence of the power of information transparency it is not clear how much of the reduction in reported toxic releases were a result of transparency or that all reported reductions were real (Koehler and Spengler 2007). Based on an examination of three post TRI disclosure programmes in the USA, Beierle (2003) identifies a need for disclosure programmes to have a clear purpose and to design information sharing mechanisms that will fulfil that purpose. Information disclosure on its own may not be sufficient to bring changes in behaviour and contra wise in some circumstances simply requiring organisations to collect data can bring improvement. Beierle’s analysis of post TRI programmes identified a number of design principles that need to be followed for disclosure to achieve instrumental objectives.

- The disclosure programme must require the collection of new data that gives business managers a clear sense of what to target and an ability to measure improvement against the investment made. Managers are motivated when they have new information to act upon and that enables progress to be monitored.
- Information must empower communities if it is going to increase the pressure on organisations to invest in environmental improvement. Local communities need to be able to use their greater understanding of environmental risks in accessible and significant forms of dialogue with industry and public agency staff. At present, resource consent processes are the main opportunity for public participation but they can be a complex, drawn out and demanding for community groups to sustain involvement in.

- The costs of collecting data, actual or perceived, are a potential source of industry resistance to disclosure programmes. Additional costs are involved if information must be released to public agencies and the community but the main costs arise from the collection of data rather than its dissemination. Further insight is needed into the costs of data collection in order to understand the factors that contribute to higher costs and how the use of information technology may help to reduce them.
- Data quality is critical to the effectiveness of disclosure. The key challenge is that disclosure tends to release only part of the information needed for a complete risk assessment. Fragmentary information combined with established perceptions of risk can lead the public to over- or under-react to information compared with what a full technical assessment of the risk might suggest is justified. This context can strain the credibility of disclosure where NGOs, the media and companies make competing claims over the significance of the fragment of the risk assessment that is disclosed.
- Risks associated with the unintended use of data need to be managed. Following the September 11 terrorist attacks in the USA, that country's Environmental Protection Agency produced some guidelines to help reduce the usefulness of environmental disclosure data to criminals. These include taking note of the ability to combine data with other information to create more insight into a plant and controlling the release of sensitive information.

New Zealand has made little use of public disclosure as an environmental management tool. In 1996, the OECD recommended that member nations introduced Pollutant Release and Transfer Registers to provide a public database of industrial releases to air, water and soil and of waste transported to treatment and disposal sites. The New Zealand government declined to act on the recommendation, according to the OECD (2007: 173) because it considered existing legislation provided sufficient control.

2.4 Voluntary Initiatives

Voluntary initiatives are a third environmental management tool. They have been defined as 'all those actions unenforced by law and unpersuaded by financial incentives, which individuals, groups and firms take to protect the environment' (Jacobs 1991). The public policy interest in such initiatives arises partly because government can influence the design, implementation and impact of voluntary regulation. In other words, a good deal of the activity classed as voluntary environmental improvement is not purely self-motivated. Public agencies can encourage the willingness to participate by establishing frameworks or institutions to develop and administer voluntary initiatives or to verify their quality. Governments can make information on environmental performance publicly available raise public awareness of the existence of voluntary initiatives and threaten industry with regulation to increase participation (Gouldson and Murphy 1998).

A Canadian study identified four reasons why businesses may participate in voluntary action (Labatt and Maclaren 1998).

- The threat of regulation encourages actions to pre-empt or influence future regulation, for example signalling that adoption of a particular technology can substantially resolve the matter.
- Perception that public image affects business.
- Financial advantage, through the direct returns from environmental improvement and improved standing with financial agencies and enhanced employee commitment to the organisation.
- Peer pressure through industry associations and other channels.

The case for greater use of voluntary approaches suggests they can be both more efficient and more effective than mandatory regulation. Of course, if environmental initiatives are purely voluntary it can be questioned whether this action amounts to an environmental management tool comparable with command and control regulation or market-based instruments (Sterner 2003: 119). In practice, the voluntary action being talked about frequently involves some degree of negotiated and verifiable contract between those taking the action and environmental regulators. Labatt and Maclaren (1998) refer to this as setting a 'voluntary challenge' to distinguish it from other types of voluntary action.

An informative case of voluntary action involved the early participants in controlling greenhouse gas emissions in the USA. In the early 2000s around 60 large corporations were identified as having joined voluntary programmes to cut their emission levels (Hoffman 2005). Some of the programmes were formalised to the extent of companies signing up to emission targets that could be met through emissions trading or the purchase of greenhouse gas offsets. Kruger (2005) notes three benefits that motivated participants to join such action.

- Companies gain experience that helps them assess and respond to potential regulatory policies. At least some hope that their experience will assist them gain influence over the design of any policy that is implemented.
- Voluntary actions may limit the options available to policy makers because they can be presented as a precedent that has to be followed. This can constrain policy makers to adopt a less advantageous policy design. For example, a prior voluntary tradeable emissions scheme may make it harder to introduce a mandatory scheme based on the auctioning of permits as compared with allocation according to the grandfathering principle.
- Business partly judges that their proactive investment will be recouped as future policy targets would likely be backdated to enable them to gain credit from their proactive emissions cutbacks.

This experience suggests that significant voluntary action tends to occur only under specific circumstances. More generally, Sterner (2003: 122) cites research that finds that the claimed successes of voluntary action tend to be overstated. For example, the oil and energy company Royal Dutch Shell has voluntarily affirmed support for the Kyoto Protocol on greenhouse gas emissions and announced targets for cutting its carbon emissions. As with other oil companies, process emissions only are being controlled associated with Shell's production activity. This overlooks the ultimate total emissions related to the burning of their fuels, which are of much more environmental significance (Sterner 2003). A similar situation may be thought to exist with New Zealand's voluntary approach to reducing packaging waste (Box 2.6). Some proactive 'green' companies operate in industries with an inherent interest in environmental awareness (such as health products, cosmetics and travel), some may be driven by motivated managers but other times going green is more of a preemptive business strategy. Voluntary action can motivate and mobilise employees but generally it does not appear to lead to substantial investment in environmental improvement initiatives.

Box 2.6 Case Study: Voluntary Action and the Packaging Accord (Source: Packaging Council of New Zealand 2008; http://www.packaging.org.nz/packaging_stewardship/packaging_stewardship.php)

The Packaging Accord was signed in August 2004 between the government and the Packaging Council of New Zealand, an industry association for the packaging and packaged goods industry. Local Government New Zealand and Recycling Operators of New Zealand endorsed the accord, the second to be signed with the original 1996 Accord concluded in 2001. The second Accord ran up to 2008 and has been followed by a Packaging Product Stewardship Scheme that was launched in 2010. The Accord was a voluntary initiative to cut down on wasteful packaging. It set recycling targets to be met by 2008 for the amount of material to be recovered as a proportion of that consumed. These targets were; aluminium 65%, glass 55%, paper 70%, plastic 23% and steel 43%. By 2008 these targets had been exceeded for aluminium, glass and steel and in the other cases matched the target. Nonetheless with the volume of packaging consumed per capita continuing to increase the absolute reduction in waste going to landfill was modest. The Packaging Product Stewardship Scheme addresses this by setting objectives for improved packaging design and systems to reduce packaging waste. It also intends to encourage greater use of recycled materials and to promote increased consumer awareness and understanding of sustainable packaging. As of August 2011, 20 companies had pledged support for the stewardship scheme.

Critical thinking question: What evidence would demonstrate to you that voluntary control of packaging waste is working?

2.5 Policy Selection

Having identified a range of environmental management tools it is appropriate to ask what determines the selection of one instrument in preference to another. There are two ways of explaining policy choices. A normative approach focuses on the choice that ought to be made according to policy theory and evidence of how policies have operated in practice. A political economy approach looks at how choices have been made in practice noting that the preferences of interested parties (politicians, public agency staff, environmental campaign groups and affected businesses) have potential to influence environmental management choices.

As well as these alternative approaches to explaining policy choices, it is important not to overlook that any approach requires a supporting 'policy infrastructure'. For example, New Zealand does not have generic legislation to support the introduction of economic instruments (Guerin 2004). This is a barrier to the use of economic instruments as they tend to be demanding in terms of their needs for establishing the nature and amount of resource rights, the relationship with other rights, tracking who owns them and providing for their exchange. Present policy infrastructure fits more easily with the use of standards and permits.

2.5.1 Normative Guidance

Economic analysis can recommend when a particular tool is likely to be more or less appropriate but it does not offer a simple set of instructions. A wide range of influences need to be considered when determining which particular policy approach is likely to be most effective. One set of considerations relate to the costs organisations may face to improve their performance. For example, if the costs to individual organisations vary widely it may result in some organisations having large expenditures and others relatively little. These circumstances suggest a management tool that equalises the expenditure made by organisations rather than the performance level attained. A further consideration is the extent to which technological change will reduce environmental improvement costs. Significant changes in technology that lessen the cost of abatement give opportunity to push up improvement targets. This suggests a management approach that can rapidly adjust the target aimed for.

A second set of considerations relate to the nature of the environmental damages that are being managed. Where the incidence of environmental damage from activity or emissions is affected by the precise location, time or other circumstances it may be desirable to maintain control of individual sources. Not all management approaches give this level of control. Impacts of industrial chemicals and agricultural pesticides can be complex because it depends on the precise usage and mixing of substances. Some management approaches perform better than others in dealing with environmental impacts that are affected by a combination of circumstances. If environmental impacts are sensitive to a particular threshold value, a high level of assurance that impacts stay below that level is needed. Similarly if the issue is affected by an international environmental agreement, a precise policy goal may need to be met. Again, management approaches vary in their ability to deliver a specific performance level.

A third set of issues relate to the practical ability to control an environment issue. The ability to observe that people and organisations are complying with a management requirement will affect the effectiveness of the intervention. Impacts arising from many small, intermittent and dispersed actions are harder to police than those from a single, large establishment. Where an industry generating an environmental problem is dominated by a small number of businesses the possibility for strategic responses that frustrate environmental policy objectives arises: management approaches may need to be able to respond to this.

Assessing such considerations has led to guidance on what conditions suit what type of management approach (Table 2.4). Such guidance is best treated as a starting point for discussion as policy makers may have other concerns as well such as fitting environmental management to expected levels of inflation (high inflation will undermine the impact of a fixed price incentive), the extent of resistance to the policy and the relative burden on high and low income households. Detailed aspects of each management tool also add to the complexity of making policy selections such as how to allocate tradeable permits, the size of deposits and refunds and whether they should be equal or higher for refunds (as an additional incentive to return noting that not all deposits will be repaid).

2.5.2 Political Economy Guidance

A political economy approach examines what influences policy choice in terms of the relative influence of different social groups and their preferences. Stavins (2003) thus asks how policy selections have been made in practice including whether they are informed by evidence of effectiveness. He suggests that a shift toward favouring market-based instruments at the expense of 'command and control' approaches is better explained by social forces than evidence of policy effectiveness. His judgements were developed in the context of the development of environmental management in the USA but they would seem to apply equally to other regions of the world including New Zealand.

Traditionally all the main affected parties had reasons to favour command and control approaches. An industry-by-industry focus attracted business support of command and control approaches because it tended to make it easier for businesses to influence the design of regulation than where policy encompasses multiple industries and has a focus on the quantity of pollution, not on who generates it or the technology used. Partly because it gave them expertise and power, policy makers too tended to resist the use of alternative policy instruments. They presented moves away from command and control as having an uncertain outcome and as potentially needing to confront a great deal of political content.

Table 2.4 Normative policy selection guidance for environmental policy tools

Policy approach	Conditions favouring the use of the policy approach	Policy applications
Cap-and-trade permit systems	Public-good market failure is not dominated by monitoring and information costs.	GHG emission reductions (EU-ETS)
	Sufficient institutional capacity (experience) and potential size of market sufficiently large to function properly.	Air pollution (SO_2, NOx,VOC) Fishing quotas
	Environmental damage depends on overall amount of a pollutant and not on specific location or timing of emission sources	
	Precise control over emissions is available at reasonable cost	
	Cross-border spill-over effects are important	
Taxes or charges on pollution or exploitation of natural resource	Public-good market failure is not dominated by monitoring and information costs.	Water effluents Water abstraction or Consumption
	Pollution sources are small and diffuse	
	Environmental damage depends on overall amount of a pollutant and not on specific location or timing of emission sources	
	Temporary deviations in emission levels from target have little consequences for environmental damage (e.g. flat damage function)	
	Precise control over emissions is available at reasonable cost	
Taxes or charges on a proxy (input or output)	Control of direct pollution discharge difficult or costly	Fuels and coal Motor vehicles
	Close and stable relationship between use of input or output used as proxy and targeted pollutant	
	Several pollutants associated with single input or output	Fertilisers
Subsidies	Enforcement of alternative pricing instruments is difficult or very costly	Forest management and conservation
	Activity to be subsidised is a strong substitute for targeted "dirty" activity	Purchase of environmental-friendly house energy equipment
	Subsidy programme can be designed in a relatively simple way, for a time-limited period and with minimal secondary effects	
Deposit-refund systems	Control of pollution source impossible or difficult	Beverage and chemical containers
	Solid wastes involving simple and relatively homogeneous products or heavy metals	Lead acid batteries

(continued)

Table 2.4 (continued)

Policy approach	Conditions favouring the use of the policy approach	Policy applications
CAC Performance standards	Pollution control at the source of emissions is infeasible or very costly No adequate proxy for pollutant that could be object of taxation Weak response of agents to price signals Pollution emissions can be measured from application of technology	Limits on CO2 emissions of a passenger vehicle Energy efficiency standards for various manufactured goods.
CAC Technology standards	Pollution control at the source of emissions is infeasible or very costly No adequate proxy for pollutant that could be object of taxation Administrative costs of performance standards are too high Abatement costs are relatively homogeneous across agents	Minimum percentage of a low-carbon source in the overall fuel mix of passenger vehicle Specific housing building codes for energy-saving purposes
Active technology support policies	Technology areas where market size and learning by-doing effects are dominant Infrastructures in areas where network considerations are important	Feed-in tariffs for electricity generated by renewable sources Renewable energy portfolio standard (green certificate)
Voluntary approaches	When the authorities can put strong pressures (credible threat of follow-up actions) Where information is not too costly to provide	Agreements to encourage energy efficiency in energy-intensive industries Publicly-available inventories of various pollutants

Source: OECD (2010: 6)

Environmental campaign groups opposed market-based instruments as they were likened to a ‘license to pollute’ and had the implication that environmental damage can be accommodated provided it is paid for. Environmentalists favoured giving control of the use of the environment to public agencies whereas market-based instruments implied the devolution of control to the businesses being regulated. Labour groups supported command and control regulation as it was seen as less threatening to the protection of jobs in heavy polluting activities. A shift to market-based instruments implied a relocation of activity to newer, cleaner businesses.

Stavins (2003) argues that support for command and control regulation started to break down in the 1990s. He suggests a number of reasons for the change in outlook in favour of economic instruments that had more do with the perception of the environmental issues faced than evidence that one policy approach actually works better than another.

- An increase in pollution control costs has led to a search for the most cost effective instruments. In the USA, for example, the costs of pollution control to industry were estimated as growing nearly 300% 1972–1990 (Jaffe et al. 1995). A major argument for market-based instruments is that they can redistribute improvement effort to organisations that face least cost in addressing their environmental impacts. This argument has proved influential even though market-based approaches can mean that overall expenditure to conform to regulation increases.
- Environmental groups became more willing to support market-based approaches. This followed successful use of tradeable permit programmes to reduce sulphur dioxide, lead in gasoline and CFC emissions. Critically for environmental campaign group support, these programmes were all designed to reduce emissions and not simply to reallocate the cost of control.
- A number of environmental issues arose where there was society-wide agreement on the need for action such as the evidence about the damage to the ozone layer through CFC emissions, the impact of acid rain and the environmental damage of lead in petrol. In each case, agreement that a problem existed was helped by the development of alternatives that involved little adjustment for industries or consumers (such as lead-free petrol). With agreement over policy targets, policy makers had opportunity to focus on the means for achieving change.
- The environmental issues to which the first tradeable permit schemes were addressed were all in areas where no previous environmental regulation had existed. Where there are no interests wedded to an existing, alternative environmental management regime it can be comparatively easy to get agreement to use a market-based approach. The challenge may be in the precise design of the economic incentives to be used.
- Advocacy of market-based instruments coincided with a shift in political outlook in favour of deregulation and the greater use of market forces to address social and economic problems. New approaches to environmental management have found favour in the context of a larger reform of public sector management.

In reality there are a number of constraints on the use of economic instruments that frequently limit the gain that can be obtained over command and control regulation. The advantages of economic instruments are exaggerated if it is suggested regulation means only the enforcement of a prescriptive performance standard or specified form of technology. Regulation does not have to involve the setting of uniform emissions standards. Standards now usually leave some flexibility in how and the extent to which organisations respond to environmental issues. Moreover economic instruments modify regulatory approaches rather than supplant them entirely as there can still be a need to investigate and set goals and targets for environmental quality. As management is modified rather than transformed, some costs of a regulatory system generally remain. Economic instruments are not always a practical option and it is important to understand their design requirements (see Box 2.7).

Box 2.7 Discussion Point: Standards and Permits for Vehicle Emissions (Source: Sterner 2003)

Vehicles have global, regional and local environmental impacts. The main global concern is the emission of carbon dioxide through its connection with climate change. The contribution of vehicles depends principally on the fossil carbon content of the fuel consumed but the management of climate change is complex. It requires coordination between countries, the inclusion of multiple climate gases and acknowledgement of the role of carbon sinks. At the regional scale, vehicle emissions can contribute to acid rain depending on the location of emissions, the mixing with other pollutants and vehicle characteristics. Locally, congestion, noise and air pollution are problems according to climate and weather conditions, vehicle characteristics, driving conditions and fuel characteristics.

Local impacts are especially complex: exhaust emissions can pose serious health risks but exact location matters. Inner city populations are more exposed to health risks than those outside of cities. Vehicle age matters too. The most damaging pollutants (volatile organic compounds, nitrogen oxides and particular matter) have reduced in the order of 5–10 times over the last decade. Future emissions are potentially much lower than present ones depending on the extent to which the vehicle fleet is renewed and how renewal changes the profile of the fleet. Engine temperature, weather, fuel, driving style and congestion further influence the total environmental damage. In cold weather, a significant share of emissions occurs at the journey outset even if the trip is a long one. Congestion affects the rate of emissions per distance travelled and the density of emissions.

With complex environmental impacts, physical and regulatory measures remain the main ways of controlling the impacts of road transportation: traffic management, speed controls, mandatory equipment, fuel quality regulation, mandatory inspection and maintenance the urban planning controls. Emission standards can be criticised for producing excessively clean cars in rural areas and insufficiently clean ones in city centres. In theory, a combination of road pricing (with pricing varied according to the location of highway, the type of vehicle and time of day) and vehicle taxes differentiated according to vehicle characteristics could give better control than imposing vehicle performance standards. Road charges could make it expensive to drive where and when environmental impacts are high and to encourage an environmentally optimal mix of vehicles. This would require sophisticated technology and would not protect citizens from drivers who prefer to pay and pollute.

Critical thinking question: What challenges need to be overcome to shift from standards and permits to market-based instruments for the control of the environmental impacts of road transport?

2.6 Conclusion

New Zealand's environmental management system makes use of all three main approaches reviewed in the chapter: command and control regulation, encouragement for voluntary action and economic instruments. As elsewhere it has been suggested that more use should be made of economic instruments. The Parliamentary Commissioner for the Environment, for example, identified the investigation of economic instruments as a priority area in his 2003–2007 Strategic Plan and subsequently reported positively on their ability to control waste generation (Parliamentary Commissioner for the Environment 2006). The introduction of an emissions trading scheme to control greenhouse gases is a major policy innovation but there are reasons to think that environmental policy will continue to rely primarily on command and control approaches. As we discuss in later chapters many of the environmental issues that New Zealand faces are cases where environmental damage is sensitive to the precise amount, concentration and location of the emission as well as the medium into which it is emitted. Such environmental problems are not well suited to the use of economic instruments.

Study Guide

End of Chapter Summary

2.1. In its broadest sense, environment management refers to the customary ways that people and organisations use environmental resources. This chapter focuses more narrowly on the main policy tools used by environmental management agencies today: standards and permits, economic instruments and voluntary regulation.

2.2 Standards and permits. The use of standards and permits is the traditional approach to environment management. It has been criticised as a 'command and control' approach that gives organisations too little flexibility in how they meet their environmental responsibilities.

2.3 Economic instruments work by changing prices or by limiting the quantity of an environmental resource that may be used or by reducing 'market friction' through information provision. Price-based instruments include environmental charges and taxes, incentive payments and tendering. Quantity-based instruments include tradeable permits and environmental offsets. Market friction reduction initiatives include labelling and public disclosure.

2.4 Voluntary initiatives do not depend on law, financial incentives or other forms of enforcement although they can be encouraged by frameworks provided by public and private sector agencies.

2.5 Normative interpretations of policy selection suggest that policy choices are guided by informed understanding of which approach will be most effective in addressing a particular environmental problem. Political economy approaches see that policy selections are guided by a wide range of influences and may not reflect evidence that the preferred approach is the most effective approach.

2.6 The greater use economic instruments has been advocated in New Zealand but a number of limitations with them need to be overcome before they can play a larger role in environmental management.

Discussion Questions

Is it fair to characterise standards and permits as a 'command and control' approach to environmental management?

How should environmental management balance the goal of protecting the environment with minimising the cost of environmental regulation (a) to society as a whole, and (b) to individual organisations affected by regulation?

Why has grandfathering been a preferred way of allocating tradeable permits? What are the advantages and disadvantages of this method of allocation?

Do voluntary approaches to environmental management merit the attention of other approaches?

How might Māori evaluation of economic instruments differ from that of other New Zealanders?

If political economy influences are a better explanation of the growth of interest in economic instruments than normative criteria, what does this imply for the future of economic instruments in New Zealand?

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Chapter 3
Agencies and Laws

Key Questions

- What influences shaped the reform of environmental management?
- How is responsibility for environmental management divided between central and local government?
- What are the key agencies and laws for environmental management?
- How does the Resource Management Act seek to balance demands for development with environmental sustainability?
- Why is the Resource Management Act controversial?
- How are the concerns of Māori addressed?

Abstract This chapter explores the main components of the environmental management system that has existed since the early 1990s. The key influences shaping the design of the system are explained and the connection to the larger reform of the public sector that occurred in the 1980s. The agencies and law that make up the environment management system are described. The Resource Management Act is the central piece of legislation and also one of the most debated parts of the environmental management regime. A guide to the controversy surrounding the Act is given by distinguishing the perspective of environmentalists, business interests and Māori. The final part of the chapter looks at New Zealand's participation in international environmental treaties which are another influence shaping our environmental laws as well as being a measure of the national commitment to the environment relative to other countries.

Keywords Concepts and Terms Parliamentary Commissioner for the Environment • Ministry for the Environment • Department of Conservation • Regional councils • Resource Management Act • National policy statements • National environmental standards • Environmental law • Treaty of Waitangi • Iwi management plans • Participation • International environmental agreements

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3.1 Reform of Environmental Management

Reforms of environmental agencies and regulation during the late 1980s and early 1990s form the basis of New Zealand's approach to environmental management. It resulted in a large amount of new legislation but not an end to ongoing environmental law making (Table 3.1). Three main influences drove the reforms (Ministry for the Environment 1997).

Table 3.1 Selected legislation related to environmental management in three time periods

Pre 1990	Post 1990	2005–2011
1840 Treaty of Waitangi	1990 Conservation Law Reform Act	2005 Fiordland Marine Management Act
1941 Soil Conservation and Rivers Act	1990 Ozone Layer Protection Act	2005 Resource Management Amendment Act
1953 Town and Country Planning Act	1990 Resource Management Amendment Act (Aquaculture Reform)	2005 Hazardous Substances and New Organisms (Approvals and Enforcement) Amendment Act
1953 Wildlife Act	1991 Resource M anagement Act	2006 Climate Change Response Amendment Act
1964 Continental Shelf Act	1991 Crown Minerals Act	2007 Resource Management Amendment Act
1967 Water and Soil Conservation Act	1993 Biosecurity Act	2008 Aquaculture Reform (Repeals and Transitional Provisions) Amendment Act
1967 Agricultural Pests Destruction Act	1993 Forests Amendment Act	2008 Resource Management Amendment Act
1971 Marine Reserves Act	1994 Ozone Layer Protection Amendment Act	2008 Climate Change (Emissions Trading and Renewable Preference) Act
1972 Clean Air Act	1994 Marine Transport Act	2008 Waste Minimisation Act
1974 Marine Pollution Act	1994 Antarctica (Environmental Protection) Act	2009 Resource Management (Simplifying and Streamlining) Amendment Act
1975 Treaty of Waitangi Act	1995 Fisheries Act	2010 Environment Canterbury (Temporary Commissioners and Improved Water Management) Act
1977 Town and Country Planning Act	1996 Hazardous Substances and New Organisms Act	2011 Environmental Protection Authority Act
1977 Reserves Act	1996 Ozone Layer Protection Amendment Act	2011 Marine and Coastal Areas Act
1977 Wild Animals Control Act	1996 Fisheries Act	2011 Resource Management Amendment Act

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Table 3.1 (continued)

Pre 1990	Post 1990	2005–2011
1978 Noxious Plants Act	1998 Crown Pastoral Land Act	2011 Canterbury Earthquake Recovery Act
1978 Marine Mammals Protection Act	1999 Fisheries Act 1996 Amendment Act No. 2	2011 Climate Change Response Amendment Act
1980 National Parks Act	2000 Energy Efficiency and Conservation Act	
1981 Antarctic Marine Living Resources Act	2000 Hazardous Substances and New Organisms Amendment Act	
1982 Noise Control Act	2000 Forest (West Coast Accord) Act	
1983 Fisheries Act	2000 Wildlife (Penalties and Related Matters) Amendment Act	
1986 Environment Act	2002 Aquaculture Moratorium Amendment Act	
1986 Fisheries Amendment Act	2002 Hazardous Substances and New Organisms (Genetically Modified Organisms) Amendment Act	
1987 Conservation Act	2002 Energy Efficiency and Conservation Act	
1987 Nuclear Free Zone Disarmament and Arms Control Act	2002 Local Government Act	
1988 Customs Import prohibition (Chlorofluorocarbons) Orders	2002 Climate Change Response Act	
1989 Local Government Amended Act	2003 Hazardous Substances and New Organisms Amendment Act	
1989 Local Government Reform Act	2003 Land Transport Management Act	
	2004 Hazardous Substances and New Organisms (Transitional Provisions and Controls) Amendment Act	
	2004 Building Act	
	2004 Foreshore and Seabed Act	
	2004 Resource Management (Aquaculture Moratorium Extension) Amendment Act	

Source: Updated from OECD (2007: Table 4.4)

First, there was a desire to simplify a system that had expended to address a widening agenda of environmental issues. New areas of concern had tended to attract specific regulation with administrative oversight similarly dispersed among specialised agencies. The OECD among others concluded that the approach to environmental management was piecemeal and incremental (OECD 1981). Reform brought the consolidation of legislation separately governing land, air and water resources under the Resource Management Act 1991 and the streamlining of agency responsibilities. Local government was allocated the primary responsibility for environmental management, operating within guidelines set by central government agencies.

Second, environmental management was caught up in a wider shake up of New Zealand's economic and political life during the 1980s. A sharper demarcation between commercial and public good activities gave some agencies a clear mandate for conservation. In the past a government agency may have managed a resource with commercial and conservation objectives. For example, the New Zealand Forest Service had responsibility for protecting indigenous forest and for converting indigenous forest into commercial plantation forest. These roles are now separated: commercial activity of former government agencies has either been sold to private ownership or allocated to state owned enterprises that are expected to generate profit and demonstrate efficiency in the same way as private companies. Environmental assets are now predominantly under the control of the Department of Conservation whose remit is to protect and enhance the natural environment. Reform of political institutions affected environmental management by facilitating the devolution of greater responsibility to local government than previously would have been possible.

Third, environmental management was updated in line with international thinking and obligations. The Resource Management Act introduced the idea of sustainability into resource management. Other reform reflected support for international conventions. By 1996 New Zealand was party to 48 international environmental agreements of which half had been ratified after 1985 (Ministry for the Environment 1997: Figure 4.4). Agreements relating to marine pollution, ozone depletion and traffic in endangered species were among those requiring domestic regulation. More recently, ratification of the Kyoto Protocol to implement the Framework Convention on Climate Change resulted in the introduction of an emissions trading scheme to bring greenhouse gas emissions under control (Chaps. 2 and 7).

The individual agencies and laws making up the environmental system are discussed in turn as the chapter progresses. As well as the performance of the specific components of the system, three broad questions can be asked about how well the system is working.

3.1.1 Has the System Been Simplified?

A key goal of the reforms was to reduce the number of agencies with significant environmental responsibilities and to integrate regulation in fewer laws than previously existed. This was to bring better coordination between different parts of the system and to make it easier for people to identify and meet their responsibilities. Whether the concentration of responsibilities was matched by the resources to carry out the tasks allotted the new 'super departments' and integrating legislation is one

Table 3.2 Species classification under the Wildlife Act 1953

Species category	Control	Wildlife examples
Protected	Absolute prohibition	All native animals with a few exceptions that are periodically made available for sustainable harvest (mahinga kai)
Game	Can be hunted within specified seasons	Canada goose, black swan, pukeko, mallard duck
Partially protected	Can be killed if causing damage or injury to land or property (including farm animals), subject to the relevant regulations.	Black shag, harrier hawk and little owl
Periodically able to be hunted	Hunting is at the discretion of the Minister of Conservation	Black swan, mutton bird, pukeko, little shag, South Island weka
Not protected	Unless declared otherwise by the Minister of Conservation, hunting of these species is prohibited	Horses (except Kaimanawa wild horses)
Noxious animals	Subject to the provisions in the Wild Animal Control Act 1977	Deer, goat, possum
Terrestrial and freshwater invertebrates	Classified as animals to be within the provisions of the Act	Weta, salmon, scarab beetles
Farming of unprotected animals	Certain unprotected species cannot be farmed, breed, sold, captured, conveyed or keep in captivity without permission of the Minister of Conservation	Ferret, polecat, stoat or weasel

question that has been asked. For example, implementation of the Resource Management Act envisaged the production of national policy statements but these were slow to emerge because of a lack of funding for Ministry for the Environment. Devolution of responsibility to local government was in one sense a simplification because it concentrated decision making at one tier of government. It also brought complexity by allowing variability between individual local authorities and gave responsibility to councils who were frequently poorly resourced to carry out their responsibilities.

3.1.2 *Is Environmental Management Guided by Core Principles?*

Adherence to a common set of principles is one way of bringing order to an otherwise fragmented system. In the past, the Ministry for the Environment (1997) has claimed that four unifying principles help to integrate agencies and laws:

sustainability, the precautionary principle, 'user pays' and 'polluter pays'. Those who are critical of the effectiveness of New Zealand's environmental regulation caution that high-minded and well-meaning principles such as sustainability can in practice be defined too loosely to have any real significance (Wheen 2002: 261). Similarly, the precautionary principle has been incorporated into laws governing hazardous substances and new organisms, biosecurity and fisheries but without a consistent understanding of its meaning (Cameron 2006). The polluter pays principle is expected to bring green taxes and other pollution charges as ways of controlling environmental problems. The OECD and the Parliamentary Commissioner for the Environment have both been claimed that too little use is being made of such instruments to make polluters pay (Parliamentary Commissioner for the Environment 2002: 54; OECD 2007: 128). Questions therefore remain as to whether a common set of principles have driven reform but as discussed in Chap. 4 this is partly because environmental management principles do not easily translate into specific policy guidance.

3.1.3 Are Regulatory, Market and Voluntary Approaches Balanced Appropriately?

The redesign of the environmental management system primarily involved a change in the scope and objectives of regulation rather than a shift between the use of regulations, incentives and voluntary action. Questions continue to be asked about whether the balance between the three approaches is appropriate. As noted above, the OECD and Parliamentary Commissioner for the Environment have been among those calling for a shift from regulation to more use of market-based controls (Box 3.1) along with other interests groups including the New Zealand Business Council for

Box 3.1 Discussion Point: Advocacy for Market-Based Instruments

The Parliamentary Commissioner's (2006) report on changing behaviour with respect to waste production notes that direct or indirect monetary incentives can provide the impetus and flexibility that industry needs to research and develop technologies that minimise waste. Under certain circumstances, economic instruments may deliver outcomes faster and at a lower cost than more prescriptive measures. It is suggested that policy efficiency improves by forcing those who generate waste to pay the full costs, including environmental costs, of dealing with the waste they produce. Appropriately designed, economic instruments help to fund alternatives to waste disposal, such as recycling and resource recovery, providing individuals and firms with practical and cost effective choices. Where there is a financial advantage for those who

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Box 3.1 (continued)

reduce their waste, as well as an overall benefit for the environment, economic instruments create a win-win solution that cannot necessarily be achieved by other policy tools.

Nonetheless it says that economic instruments should be viewed as complements to rather than replacements for other policy approaches. The limitations are that calculating and applying efficient waste taxes or charging rates is not easy. There may be practical difficulties, for example, in identifying and valuing environmental damage costs (especially long term impacts). If consumers are not price sensitive, charging the total cost of waste generation might not encourage a change in behaviour. Payment of charges might even be interpreted as a 'right to pollute'. Charges might be viewed as merely another tax and they may create hardship for low income households and encourage illegal dumping of waste. The cost of devising and implementing economic instruments may not make them the optimal form of control. Uncertainty about effectiveness means that certain kinds of waste will undoubtedly need to managed through command and control regulation (notably hazardous waste).

Critical thinking question: What do you conclude about the scope for introducing economic instruments to minimise waste generation?

Sustainable Development. Industry groups often believe too little reliance is made of voluntary self-regulation, for example pointing to waste management as an example where much change has been encouraged without regulation (see Chap. 10).

3.2 Central Government Agencies

It is appropriate to first identify the central government environmental agencies involved in environmental management as they set the context for local government involvement. During the 1980s and 1990s the number of central government agencies with significant environmental policy and resource management responsibilities grew. Compared with what went before, the responsibilities of individual agencies have a clearer focus on environment or development. Consequently, despite the multiplication of agencies it is still possible to claim that the system as a whole became more integrated than it was. Six agencies or types of agency that are part of or linked to central government have significant roles in the environmental management system.

- Parliamentary Commissioner for the Environment
- Ministry for the Environment
- Department of Conservation

- Other policy making departments (Ministry of Agriculture and Forestry and the Ministry of Economic Development)
- Development agencies
- Crown entities (Energy Efficiency and Conservation Authority and the Environmental Protection Authority)

3.2.1 Parliamentary Commissioner for the Environment

The Commissioner is an independent watchdog over the environmental management system. This role was established by the Environment Act 1986 to be a form of ombudsman with powers to investigate how the environmental management system as a whole is operating rather than investigating individual complaints. The primary task is to monitor and report directly to the New Zealand legislature (House of Representatives) on the performance of agencies and policies with respect to environmental outcomes (Bührs and Bartlett 1993: 118; Memon 1993: 52). For example, from 1987 to 1996, the Commissioner's Office produced nine reports about Māori and the Treaty of Waitangi that provided important guidance on how environmental agencies might obtain Māori involvement in environmental management (Wickliffe 1997). In 2001, the Commissioner was given an additional task of regularly auditing the environmental performance of the Electricity Commission (a body with the objective of ensuring 'that electricity is generated, conveyed and supplied to all classes of consumers in an efficient, fair, reliable and environmentally sustainable manner').

When established it appeared that the capacity for critical examination of the government's policy decisions made the Commission a significant concession toward environmental improvement (Woollaston 1997: 7). Initially it was expected that auditing of environmental assessments would be a major function of the Commissioner's office (Wallace 1997: 93). During the early years there was not a flow of major projects giving rise to contentious impact statements to support such a role. Instead the Commissioner has concentrated on the overall policy settings affecting environmental issues of national significance. In determining its real importance, the resources allocated to the Commission as well as the wide ranging remit need to be considered. In the years immediate prior to 2010, the Commission typically had a staff of around 15 and an annual budget of $2–2.7 million. With few resources, the challenge is to strike a balance between small scale questions of immediate practical significance and system wide evaluation (Bührs 1996). Post 2005, the emphasis has tended to shift toward investigating specific environmental issues. Principal activities in 2008–2009 included investigations into the clean-up of Mapua, a former agricultural chemical depot and manufacturing facility (rated New Zealand's most contaminated land site), the management of a landfill site causing local environmental concerns, the potential for 'smart' electricity metres and high country land tenure (Parliamentary Commissioner for the Environment 2009). While specific in immediate focus the Commissioner's interest is explained by the broader environmental issues raised.

3.2.2 Ministry for the Environment

This ministry is the main policy agency for the environment and was another product of the Environment Act 1986. Prior to its establishment, some environmental groups had campaigned for an agency that would combine responsibilities for conservation management with planning and regulatory functions. This did not fit with the fashion in public sector administration to split policy and implementation responsibilities between separate agencies. Such a division is favoured to minimise the risk of policy processes being captured by interests associated with actual resource management decisions (Bührs and Bartlett 1993: 117). Treasury as well advised against giving the Ministry power to enforce long term plans recommending that its role be limited to general direction setting (Treasury 1985).

These perspectives produced a Ministry for the Environment that was comparatively small in resource size with total staff numbering only slightly over 100 in the early 1990s. Concerns about staff resources remained in the early 2000s (Ericksen et al. 2003: 57) but from 2005 to 2010 the workforce grew from around 200 to almost 300 in 2010 (Ministry for the Environment 2010: 6). The Ministry has four main outputs.

- Policy advice to the government on environmental management, the state of New Zealand's environment, solutions to environmental problems and new opportunities to improve the environment.
- Tools and techniques for environmental improvement (such as guidelines, regulations and best practice case studies).
- Information and education as a contribution to raising public awareness about the sustainable management of the environment.
- Monitoring and reporting on the performance of entities for which it has responsibility: the Energy Efficiency and Conservation Authority (EECA) and the Environmental Protection Authority (EPA).

On establishment, the Ministry's responsibilities were less than some environmentalists had sought but the broad policy advice function was seen to give environmental concerns increased influence within government (Memon 1993). Whereas previously the Treasury had a large influence over environmental policy, the Ministry for the Environment can now offer countervailing advice on any policy proposals with significant environment implications submitted to Cabinet or its committees. Treasury advice tends to emphasise fiscal responsibility and market efficiency. The Ministry's concerns include the intrinsic value of ecosystems and resource sustainability (Wheen 2002: 269). In 1995, the Ministry published the Environment 2010 Strategy (Box 3.2). It was claimed to be the first comprehensive statement of environmental priorities and strategies released by any New Zealand government. The strategy was discontinued in 1999 as policy linked to sustainable development became the priority with waste, energy, biodiversity and oceans strategies released in the following years.

Box 3.2 Discussion Point: Environment 2010

The Environment 2010 strategy (Ministry for the Environment 1995) provides a framework for resource management. It aimed to focus effort by promoting a vision of a 'clean, healthy and unique environment, sustaining nature and people's needs and aspirations' rather than by directly changing management responsibilities. Eleven priority issues were identified.

– Managing land resources to maintain and enhance soil quality to support a variety of land uses.
– Managing the quality and quantity of all types of water to meet human and ecosystem needs.
– Maintaining clean air in parts of New Zealand where it is already clean and elsewhere improving its quality.
– Protecting indigenous habitats and biological diversity to maintain and enhance remaining indigenous forests and other indigenous ecosystems and to promote the conservation and sustainable management of plants and animals.
– Managing pests, weeds and diseases so as to protect species diversity, human health and reduce risks to the economy.
– Sustainable fisheries to benefit the fisheries and provide for commercial, recreational and customary use.
– Managing environmental impacts of energy services so as to retain the effects of producing and using energy within sustainable limits.
– Managing environmental effects of transport services to protect the health of the environment and humans while maintaining transport activity.
– Managing waste, contaminated sites and hazardous substances including the cleanup of already contaminated sites as well as protecting against new risks to environmental and human health.
– Reducing the risk of climate change by addressing levels of greenhouse gas emission and meeting New Zealand's international obligations under the Framework Convention on Climate Change.
– Restoring the ozone layer to help achieve its full recovery and constrain peak levels of ozone destruction by phasing out imports of ozone depleting substances.

Critical thinking questions: What do you think about this list of environmental challenges? Have any of these concerns become less of a priority than they were in 1995? Are there any additional issues that need to be added?

Since formation, the Ministry has extended its influence with activities that border on Treasury's conception of planning. The Ministry has described its work as 'developing transition paths' as well as 'protecting the foundations' (Ministry for the Environment 2002). Developing transition paths involves the Ministry in proactively looking forward 20–30 years, mapping a target to where New Zealand wants to be and providing the tools, information and motivation to support steps in that desired direction. Energy, water, waste and transport are key sectors where the Ministry has tried to push New Zealand to more environmentally sustainable growth path. Of these, the waste reduction strategy is the most advanced (Chap. 10).

The Ministry's 2008 briefing for the incoming government (Ministry for the Environment 2008: 10) identified six critical issues facing New Zealand's move toward environmental sustainability (broadly understood as a healthy environment with healthy functioning ecosystems that provide for human wellbeing).

- Meeting New Zealand's international climate change: obligations, reducing greenhouse gas emissions and adapting to climate change.
- Freshwater quality decline, demand pressures and allocation.
- The role of the Resource Management Act in providing for environmental and socio-economic outcomes and allocating scarce resources.
- Developing natural resource policy and management arrangements that better reflect the Treaty of Waitangi relationship and managing some emerging issues with the use of natural resources in Treaty settlements.
- Pressure on biodiversity and ecosystems.
- Environmental pressures and allocation issues for New Zealand's oceans, particularly the near-shore marine environment.

These concerns are reflected in the Ministry's priorities for the period 2011–2014 except that climate change does not appear among the top priorities (Ministry for the Environment 2011). The top most priority is the improved management of freshwater resources by implementing actions envisaged in the 'Fresh Start for Fresh Water Strategy' (see Chap. 6). The concern with resource management processes are reflected in the priority attached to bedding in the EPA and on-going reforms of resource management regulation. Particular importance is attached to improving management of the Exclusive Economic Zone responding to a long recognised gap in New Zealand's environmental management (Chap. 7). The final priority area is to improve the evidential base for environmental policy making through better collection of environmental indicators and more systematic reporting on the state of the environment.

3.2.3 Department of Conservation

Whereas the Ministry for the Environment was characterised as the 'ministry in the middle', the Department of Conservation was set up under the Conservation Act in 1987 as 'an advocate for conservation' (see Bührs and Bartlett 1993: 117). This founding legislation defined conservation as:

> The preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations (Conservation Act 1987, Section 2(1)).

This narrow purpose contrasted with the original intention of creating an agency that would be responsible for promoting multiple uses of protected areas, including productive uses such as logging. In the event, the environmental lobby won out and changed a potentially multi objective department into one with a stewardship function, managing environmental resources to retain their inherent character (Memon 1993: 67). With a clear pro-environment remit the Department was expected to provide a counterweight to more development orientated agencies within the public sector policy process. Somewhat reducing this rebalancing was the dependence of the Department on user pays charges. Up to the mid-1990s, there were many allegations of resource shortages hampering the Department's ability to carry out its functions (Box 3.3). In 1995, an official review of the agency's funding led to significant reorganisation and additional funding (State Services Commission 1995). More recently concern has been expressed about the extent to which the Department is reliant on income from granting concessions for commercial operations on conservation land and the receipt of payments from development proponents in return for not pursuing objections (see Wouters 2011 for comment on the former review).

Box 3.3 Discussion Point: Shortcomings in the Department of Conservation (Source: Young 2004; Espiner 2009)

In 1995, a viewing platform constructed by Department of Conservation staff in a remote part of the Paparoa National Park collapsed killing 13 polytechnic students and one conservation officer and serious injuries to four others. An accident investigation identified poor building techniques, inadequate training and inspection procedures and other staff deficiencies. A State Services Commission inquiry found that the Department was inadequately resourced but that this was not the cause of the collapse of the platform. Rather an excessive male, 'can do' culture was ultimately responsible, although this same culture was also noted to be benefiting conservation. Following the Cave Creek disaster, management tiers were strengthened and clearer lines of accountability demarcated, creating more of a conventional modern bureaucracy while still aspiring to be a world leader in recreational opportunities management.

In 2009 the Department of Conservation was one of several parties accepting a payment from the electricity generator Meridian in return for agreeing to inform an inquiry panel investigating Project Hayes, a proposed wind farm and any other court examining the project that its previous concerns about the visual impact of the project had been resolved. An agreement between the two parties stated that the money (NZ $175,000) would help maintain and improve access to the Rock and Pillar Conservation Area and/or to fund research into the decline of the eastern falcon. A spokesperson for Meridian was reported as saying that such payments were 'common practice' and allowed the

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Box 3.3 (continued)

company to seek solutions to community objections rather than the costly and time-consuming process of taking it to court. The Parliamentary Commissioner for the Environment, Morgan Williams said that the agreement appeared to be a case of 'buying silence to avoid political embarrassment.' The Department of Conservation subsequently identified 12 financial agreements it had negotiated prior to the Meridian agreement saying that they were all to fund environmental work to mitigate the impacts of proposed developments.

Critical thinking questions: Examine how the annual budget and staff numbers of the Department of Conservation have changed since 1995. How do they compare with other public sector activities (for example education, health or police)? Does the Department get sufficient resources to carry out its responsibilities?

The Department has responsibility for giving policy advice on conservation matters to the government and for managing all the 'conservation estate', comprising national parks, wildlife sanctuaries, marine reserves and historic reserves (Chap. 5). This includes protecting indigenous biodiversity and promoting nature and heritage protection on and off the conservation estate. In effect, this put the Department in charge of about 30% of New Zealand representing a considerable direct responsibility for the environment (Young 2004: 211). In place of the 'green dots' of environmentalism scattered across diverse agencies, conservation obtained a strong advocate within central government (former Minister of Conservation Russell Marshall cited in Young 2004: 207). Optimistically, the new Department can take a whole ecosystem approach to conservation whereas previously habitats and wildlife sometimes had separate management.

A significant transfer of land ownership accompanied the creation of the Department of Conservation. This was relatively straightforward in the case of national parks and other protected areas that had a single purpose consistent with the Department's conservation mission. Land in multiple use was allocated according to whether it was primarily in productive use or to be conserved and placed under the Department of Conservation's control (Memon 1993). This issue continues to exist, particularly with respect to the crown owned pastoral lands in the South Island high country (Chap. 5).

As well as reporting to central government, the Department is required to support local authority resource management planning with information and advice as well as to advocate conservation opportunities to them. An additional specific task is to prepare the New Zealand Coastal Policy Statement and to work with regional councils in the management of the coastal area. This special status afforded the coastal environment (responsibility for managing other resources is delegated to local authorities) responded to particular pressures much of which was associated with building of holiday homes within view of the shoreline (Young 2004: 200). The second Coastal Policy Statement was released in 2010.

3.2.4 Other Policy Making Departments

Some specific areas of policy relevant to the environment remain outside the Ministry for the Environment. The Ministry of Agriculture and Forestry provides policy advice and manages programmes aimed at achieving the sustainable exploitation of land based resources and, since merger with the Ministry of Fisheries, fishery resources. The Ministry of Economic Development has responsibility for energy policy and coordinating the government's responses to climate change and ozone layer protection. It accommodates the New Zealand Climate Change Office that has responsibility for designing and negotiating greenhouse gas agreements with large emitters. The Ministry of Economic Development is of further influence through its monitoring of the compliance costs of environment regulation and otherwise considering impacts on the business community. A prominent environmental campaigner has alleged that environmental issues outside the domain of the core environmental agencies have had less attention than they would have had without the division of responsibility (Wallace 1997).

3.2.5 Development Agencies

The concentration of the commercial activities of the state into state owned enterprises was a product of the public sector reforms of the 1980s. From the government departments that had formerly combined 'dual mandates' for development and environmental management were created the Forestry Corporation of New Zealand Ltd, Land Corporation Ltd and the Works and Development Corporation (Bührs and Bartlett 1993). In 1996, a further separation occurred when the Department of Survey and Land Information was restructured to form Land Information New Zealand and TerraLink, separating land information policy functions from commercial activities.

3.2.6 Crown Entities

These agencies complement the role of central and local government by offering advice, performing specialised policy and management functions and devolving decision making. In the past, they were popularly known as quangos (quasi autonomous non-government organisations). That term has acquired negative associations reflecting concern that governments are too prone to overlook the dangers of fragmenting administrative responsibilities when setting up additional agencies. In the early 1980s, almost 30 environmental quangos existed (Memon 1993: 108). A significant rationalisation of these entities came in 1987 with the setting up of the New Zealand Conservation Authority. This new agency is serviced by the Department of Conservation and being without governance responsibilities it falls outside the remit of the Crown Entities Act. It performs the functions of several former quangos with the central role of providing the Department of Conservation with comment on and approval of conservation management strategies for National Parks and other protected areas. The New Zealand Fish and Game Council was established in 1990 to represent the interests of anglers and hunters, and provides co-ordination of the management, enhancement, and maintenance of sports fish and game as required by the Conservation Act 1987. As most hunted species in New Zealand are regarded as pests and because most hunting takes place on public land, it has been possible to integrate hunting with conservation management.

Surviving crown entities come under the remit of the Crown Entities Act 2004 which has clarified aspects of their relationship to central government. This allows the responsible government minister to direct an entity to have regard to government policy but not to direct it on matters relating to its statutorily independent functions. The two most significant environmental entities are the Energy Efficiency and Conservation Authority (EECA) and the Environmental Protection Authority (EPA), with both reporting to the Minister for the Environment.

The Environmental Protection Authority became operational in mid-2011 and as well as its roles in resource consents of national significance it will undertake some administrative tasks for the Emissions Trading Scheme and took over the work of Environmental Risk Management Authority (ERMA). Prior to the EPA, the Minister for the Environment could call in applications but the formation of the EPA signaled intentions to take more applications out of the control of local authorities. This responded to concerns that projects of national economic significance were deterred by extended consultation and approval processes and where it is felt the issues are most appropriately determined nationally rather than regionally (see below).

ERMA had been established under the Hazardous Substances and New Organisms (HSNO) Act 1996 with the main role of determining applications to import, develop, or field test new organisms and applications to import or manufacture hazardous substances. Prior to its establishment, New Zealand was one of the few OECD countries without a central agency charged with pollution and hazardous substance control (Bührs and Bartlett 1993: 145). During 2002–2004, ERMA received 104 applications relating to new organisms and 174 for hazardous substances (ERMA 2004). During 2007–2009, the number of applications being dealt with had grown to around 350 in both categories (ERMA 2009). As well as approval to use a hazardous substance controls can be imposed throughout the life cycle of the substance covering issues such as labelling, packaging and disposal. Guidance on safe use practices is developed partly through codes of practice. It has fallen to the New Zealand Chemical Industry Council to take the lead in developing these codes which can be seen as leaving an important task to a poorly resourced body (Box 3.4).

Box 3.4 Discussion Point – New Zealand Chemical Industry Council

The New Zealand Chemical Industry Council (NZCIC) is an industry association with a membership of around 145 mainly small organisations but also including the local operations of multinational companies. It was established in 1985 following a number of chemical incidents in New Zealand. Much of its work today is about assisting companies comply with hazardous substances control legislation. Legislation controlling hazardous substances and workplace health and safety is largely about performance-based outcomes, specifying what organisations are expected to achieve without indicating precisely how the outcomes are to be obtained. Providing guidance on what organisations can do to satisfy regulatory requirements consumes much of Association's effort. It has, for example, identified a need for 25 codes of practice to assist compliance with the Hazardous Substances and New Organisms Act (1996). It estimates that by mid 2011 around half of these had been prepared and officially recognised, some entirely at the Association's initiative others with its input. It sees these codes as vitally important for helping small businesses achieve the performance goals set by legislation but also notes that small businesses vary in their ability and inclination to fund the Association's work and that it receives no public funding despite its role in helping to implement legislation.

Critical thinking questions: Visit the NZCIC website (www.nzcic.org.nz) and identify how the Association helps reduce chemical risks in the environment. Should this work be paid for by the chemical industry and seen as a necessary obligation on those responsible for bringing chemicals into the environment? If not, what alternative ways might be used to support the Association?

EECA was established in 1992. In 2000, the Energy Efficiency and Conservation Act brought it within central government policy circles and made the Ministry for the Environment responsible for monitoring the agency instead of the Ministry of Economic Development. Its role is to promote changes in the way people think about and use energy. Guided by the target of encouraging a sustainable energy future, it seeks to influence energy choices, both by raising the awareness of energy efficiency issues in the community and by providing businesses and individuals with the tools to make changes. In conjunction with the Ministry for the Environment, EECA developed the National Energy Efficiency and Conservation Strategy (2001). The background to this strategy was New Zealand's poor performance relative to other OECD countries in respect of energy efficiency, renewable energy policy and the uptake of new technology (Parliamentary Commissioner for the Environment 2000). A new strategy released in 2011 aims to continue the decline in consumer energy intensity that has occurred since the 1990s (Ministry of Economic Development 2011).

3.3 Local Government Agencies

Environmental planning is one of the more significant functions that central government has allocated to the lower tier of administration. This was a major outcome of the reform of environmental management. Prior to the 1990s, central government had given little scope for local influence on environmental planning with some alleging this was to protect their vested interests as the country's largest developer (Memon 1989, 1993).

The Local Government Act 1987 reduced the number of local and regional units of government from more than 625 to 94 and made possible the delegation of environmental responsibility (Bührs and Bartlett 1993: 120). Associated with local government reform many special purpose boards were abolished such as catchment, drainage, river and pest destruction authorities, which had performed a variety of environment-related tasks. Regional councils were created with boundaries that followed natural river catchments rather than the distribution of population. The comparatively small number of regional councils (13 originally) reflected the goal of creating agencies with the resource capacity to support a high level of professional capability. The linkage to natural catchments underscored the importance of regional resource planning among the functions allocated the new authorities. What is now referred to as 'subsidarity' was also at work: the perceived efficiency of allocating decisions to the community level that has most insight into the issue and most incentive to manage it effectively (Bührs and Bartlett 1993: 121).

Central government retained ultimate power and authority. An amendment to the Local Government Act in 1992 directed councils to view management of the natural and physical as their primary responsibility. This was motivated by the desire to keep local government out of socio economic matters as much as to bolster their environmental management (Ericksen et al. 2003: 80). The Local Government Act 2002 restated the purpose, role and powers of local authorities and introduced a requirement for Long Term Council Community Plans (LTCCPs). These plans require that local authorities set community outcomes for the immediate and long term future of their district or region in consultation with other government agencies and their own community.

Territorial authorities exist underneath regional councils in the hierarchy of environmental plan making although the working relationship is expected to be one of equal partnership (Local Government Commission 1998). Territorial authorities complement the work of regional councils by focusing on local service requirements such as water supply, control of land development, recreational facilities and other public works. The relative merits of creating two types of local government body versus a unitary system combining the regional and territorial duties and powers in one type of authority were debated (Memon 1993). There is ongoing comment that regional councils lack capacity to adequately perform the environmental tasks allotted them (May et al. 1996; Ericksen et al. 2003; Young 2004: 209). These responsibilities include establishing, implementing and reviewing objectives, policies and methods for securing the sustainable management of natural and physical resources. Groups such as Federated Farmers question whether councils have the resources to do their job effectively. In 2010 there was a substantial change with the unification of local government in the Auckland region into a single ‘super city’ encompassing localities formerly under five former jurisdictions. This development was motivated more by the goal of improving infrastructure to underpin the region’s economic development rather than the strengthening of environmental management (Chap. 10).

3.4 Non-government Organisations

Non-government organisations (NGOs) are an influence on environmental policies and laws in New Zealand (Ministry for the Environment 1997). Groups such as the Royal Forest and Bird Protection Society, Greenpeace, the Maruia Society (formed in 1988 through the merger of the Native Forests Action Council and the Environmental Defence Society) the Federation of Mountain Clubs were especially active during the 1980s in seeking to shape the reform of the environmental management system. In the early 1990s, environmental NGOs were among the largest interest groups in New Zealand having experienced a rate of membership growth far higher than equivalent groups in the UK and USA (Bührs and Bartlett 1993: 70). This prominence was partly a reflection of the controversy sparked by government promoted large scale hydroelectric and energy projects, the so called ‘think big’ projects (Wilson 1982). Those seeking to raise objections found it hard to do so at a time when decision making tended to be centralised and secretive (Young 2001; Wheen 2002). The 1985 bombing of the Greenpeace vessel the *Rainbow Warrior* in Auckland harbour by French secret service agents was another influence swelling support for environmental NGOs (Bührs and Bartlett 1993). The ship had been seeking to stop nuclear testing in the Pacific.

Since the reforms of late 1980s, and especially the passing of the Resource Management Act there has been more scope for participation in resource management decisions than in the past (see below). The Ministry for the Environment (1997) points to openness as a reason for a decline in the membership of NGOs. The Maruia Society was one of the largest campaign groups with close to 12,000 members in 1991 (Bührs and Bartlett 1993: 70). In 2003, it became a research think tank remaining as a membership organisation but primarily seeking influence through inputs into the policy making process and by acting as a consultant to private business (Ecologic Foundation 2004). This transition was assisted by the award of a 4 year government research grant on institutions for sustainable development. The Royal Forest and Bird Protection Society on the other hand has maintained a diversified role including lobbying as well as direct involvement in conservation and had around 70,000 members and supporters in 2011. In 2011, it reported its first growth in membership numbers in 20 years which may have been connected to the public outcry against government proposals to widen opportunity to mine conservation land (see Chap. 5).

The Federated Mountain Clubs of New Zealand represents the interests of tramping and climbing clubs and is vocal on issues affecting access to wilderness areas of recreation.

3.5 Māori and Resource Management

Recognition of Māori interests has been a feature of the post 1980s environmental management system for which New Zealand has gained credit from the OECD (2001a). The need for this provision derives from the settlement agreed between the British government's representative in New Zealand and the tribal leaders of the indigenous Māori in 1840. That settlement was agreed in the Treaty of Waitangi and was intended to form the basis on which European settlement of New Zealand would proceed. Article II of the English language version of the Treaty stated that Māori were not to be denied the 'full exclusive and undisturbed possession of their lands and estates, forests, fisheries and other properties'. The Treaty gave Māori the 'rights and privileges of British citizens' in return for acknowledging the British Crown's right to govern without, in the Māori language version of the Treaty (Te Tiriti o Waitangi), ceding sovereignty ('rangatiratanga') (Parliamentary Commissioner for the Environment 1998a).

The precise obligations placed on subsequent generations are disputed but there is little disagreement that Māori lost resources and rights that the Treaty was expected to protect (Orange 1989; Durie 1998). A need to redress this situation has gained broad acceptance since the 1970s as a consequence of internal demands and pressure from international agreements affecting the status of indigenous people. The Treaty of Waitangi Act 1975 recognised the continuing validity of the treaty and created the Waitangi Tribunal to hear claims from Māori. It was established initially to make judgments on Crown actions post 1975 and relating to the prejudicial impact of any current laws. In 1985, this was changed to enable claims on actions dating back to 1840 to be brought before the Tribunal. The loss of rights in respect of land and other natural resources have formed the basis of many of the claims brought. Importantly, court rulings have established that Māori interest over land and resources is not determined by ownership (Matunga 2000). Spiritual and cultural values can be asserted and must be considered, as in the administration of water rights by regional water boards (Boast and Edmunds 1994).

At one stage government efforts were directed to formalising a partnership between Māori and the government by devolving certain administrative responsibilities to iwi (tribal) authorities. Iwi affiliation is a strong form of collective association, although there are other important groupings as well such as whänau and hapü (extended family and sub tribe). Incorporating iwi representation into the administrative framework would require their legal identity to be clarified and privilege some forms of Māori representation over others. This approach was rejected by Māori partly from suspicion that it would result merely in an administrative delegation rather than a genuine transfer of power (Boston et al. 1996: 148).

Or, as expressed by a prominent Māori academic, as the imposition of a top down construct that imposed the mainstream preoccupation with economic engineering at the expense of collective state responsibility (Durie 1998: 11). Nonetheless, iwi are the most significant collective entity participating in resource management but based on their 'mana whenua' (customary status) as recognised by the Treaty of Waitangi rather than being empowered through specific statute as in the manner of a territorial authority.

Iwi management plans have been judged a significant way that Māori express their perspective on issues relating to resource management (Sunde et al. 1999; Ericksen et al. 2003) but they have been more a feature of larger, urban based iwi. The Resource Management Act requires regional councils and territorial authorities to consider these plans. There is no prescription as to what their content should be or for iwi to formally lodge plans with any government agency. The Parliamentary Commissioner for the Environment (1998b) notes that iwi (and hapü) plans could include statements of tribal authority, rangatiratanga and rights, requirements for the management of particular resources and areas and for consultation and involvement of tangata whenua. One assessment found that the plans produced vary between comprehensive policy statements to resource specific plans (Sunde et al. 1999). The Waitangi Tribunal has recommended that iwi plans are afforded appropriate weight by councils. One assessment has found that there are no references to such documents in regional policy statements or district plans, although some councils report having supported the preparation of an iwi plan (Ericksen et al. 2003: 108). The OECD (2007: 175) reports increasing participation by Māori in environmental management issues. This can partly be explained by settlements made by the Waitangi Tribunal.

The Waitangi Tribunal is resulting in a significant transfer of resources to Māori both in the form of financial compensation and the transfer of land and other assets. Settlement of a claim involves examination of detailed historic evidence. By mid-2010, 24 claims had been settled ranging in financial value from less than $1 million to $170 million. The precise number of outstanding claims is hard to gauge as the Office of Treaty Settlements seeks to consolidate claims as part of the negotiation process but in 2010 the Office identified that it was in ongoing negotiation with 20 groups and was nearing the completion of agreements with a further 28 groups. It is important to recognize that major financial settlements have been with a few of the largest tribal authorities and that most Māori have not been materially affected to any large degree.

3.6 The Legislation Framework

Legislation over the last few decades has sought to provide an integrated approach to environmental protection and resource development by reducing the tendency for each type of resource and each stage of the resource use process (planning, management and development) to have its own statute (Williams 1997). Consequently although it is possible to divide environmental legislation into four functional areas (pollution control, conservation, resource allocation and environmental planning) individual laws may have multiple functions and objectives (Williams 1997: 21).

3.6.1 Pollution, Waste and Hazardous Substances

The Resource Management Act 1991 deals with pollution through the requirements for resource consents, land use plans and national policy statements. The Hazardous Substances and New Organisms Act 1996 established ERMA to assess and decide on applications to introduce hazardous substances or new organisms and to establish procedures for the safe use of hazardous substances. The separate legislation for hazardous substances and pollution has been linked to a tendency to view pollution as primarily local or regional in scope (Bührs and Bartlett 1993: 146). A report in the *New Scientist* (Szabo 1993) that there might be as many as 4,000 sites in New Zealand contaminated by hazardous waste encouraged environmental campaigners to see a need for more integrated control (Wallace 1997: 24).

Other important pollution control laws are the Ozone Layer Protection Act 1990 and its amendment in 1996 to bring New Zealand's ozone laws up to date with changes to the Montreal Protocol. The Biosecurity Act 1993 reformed the law relating to the introduction and effective management of pests and unwanted organisms and provided for the implementation of regional and national pest management. The Waste Minimisation Act 2008 introduced and provided for ongoing review of a waste levy, the introduction of mandatory product stewardship schemes and accreditation of voluntary stewardship schemes. In 2009 three products were under investigation for mandatory stewardship schemes: agricultural chemicals, used oil and refrigerant gases (Ministry for the Environment 2009).

3.6.2 Conservation of Natural and Cultural Resources

The Wildlife Act 1953 is the main law protecting wildlife on land and in New Zealand's territorial waters. The Act enables the designation of sanctuaries, reserves and refuges for the protection of wildlife and their habitats and classifies animals according to their need for protection (Table 3.2). The National Parks Act provides for the preservation in perpetuity of areas established as national parks. The original 1952 Act created the National Parks Authority and individual National Park boards with explicit capacity for environmental NGOs to nominate members. In 1980, the park management structure was rationalised. Park boards retained policy oversight and the Department of Lands and Survey was given responsibilities for day-to-day management (since transferred to the Department of Conservation). The Marine Reserves Act 1971, Reserves Act 1977 and Conservation Act 1987 add to the range of designations that can be made to protect natural and historic resources on land (see Chap. 5). As well as the Marine Reserves Act, the Resource Management Act 1991 gives power for local authorities to place conservation orders over water bodies to protect their amenity and intrinsic value.

3.6.3 Resource Allocation and Development

Up to the 1990s, the allocation and exploitation of mineral resources tended to be under the control of ministers or agencies whose primary responsibilities and concerns were development rather than environmental protection and conservation (Williams 1997: 24). The Crown Minerals Act 1991 set out a new regime in which three permissions are required before mining (or drilling) for minerals can commence: (i) a right to the mineral resources; (ii) a right of access; (iii) environmental consents to carry out the activity. This enables control of the direct impacts of mining while exempting mineral depletion from the sustainability provisions of the Resource Management Act. Schedule 4 of the Crown Minerals Act identifies areas of land that are explicitly closed for mining and in 2010 this identified around 40% of all Department of Conservation land (see Chap. 5). The Climate Change Response Act 2002 is a new area of resource allocation legislation. An amendment in 2008 introduced the emissions trading scheme as the principle means through which to provide incentives for reducing emissions.

3.6.4 Environmental Planning and Natural Resource Management

A capacity for proactive and macro environmental protection distinguish this area of intervention (Williams 1997). These attributes are provided by the Resource Management Act and the Fisheries Act which is legislation with claims to have been world leading (Palmer 1995). Other significant legislation in this area is the Environment Act 1986 that established the Ministry for the Environment and the Parliamentary Commissioner for the Environment. The Forests Amendment Act 1993 controls the harvesting of indigenous forest that lies outside the conservation estate (see Chap. 5).

3.7 Resource Management Act 1991

The Resource Management Act is the cornerstone of New Zealand's environmental management. It replaced 25 previously existing statutes, changed or repealed more than 150 other laws and regulations and placed much of the regulatory apparatus within a single, seamless and ambitious piece of law (Young 2001: 1). This major exercise in law making was driven by the increasing prominence and widening appeal of environment and conservation issues (Bührs and Bartlett 1993; Palmer 1995; Wheen 2002). As well as consolidating the environmental management system, at the time of introduction the Act's significance was considered threefold (Memon 1993).

- It focused on regulating the impact of human activities on the environment rather than regulating the activities themselves, concentrating regulatory effort on minimising environmental impacts while giving resource users flexibility to meet environmental goals in ways fitting individual circumstances.
- The previous implied obligation on land use planning authorities to make provision for development was replaced by a requirement to promote the sustainable management of resources.
- By controlling the externalities generated by resource use, the Act was intended to be neutral with respect to the competition between economic and environmental goals. This contrasted with the previous regime where decision makers were expected to make trade-offs between economic and environmental objectives. In practice, decision makers continue to perform a difficult balancing act in weighing up environmental impacts with development benefits (Box 3.5).

Box 3.5 Discussion Point: See Saws and Hurdles (Source: Wheen 2002; Parliamentary Commissioner for the Environment 2002: 94)

An interpretation of how the Resource Management Act is to be applied views it as a 'see saw' exercise in which attempts are made to balance conflicting objectives according to the assessment of decision makers. Another view is that it should be applied as a hurdle crossing exercise in which consents are granted subject to environmental requirements (bottom lines) being met.

The Environment Court (the principal decision maker determining interpretation of the Act) has tended to an 'overall broad judgement' approach and away from the initial expectation that the Act would introduce an environmental bottom line approach. Environmentalists tend to see the 'see saw' approach as inherently biased towards development as it pits tangible economic and social outcomes against less tangible environmental benefits. This was the source of much of the environmental criticism made of earlier legislation. A hurdle-based approach can strengthen the status of environmental considerations by maintaining the focus of regulators on the task of managing environmental effects, leaving the promotion of economic development to the responsibility of others. As well, it implies the specification of environmental objectives and standards that are followed consistently rather than being traded off against other interests.

(continued)

Box 3.5 (continued)

The balancing approach is illustrated by an Environment Court (Planning Tribunal as it then was) decision to allow residential development in a part of Canterbury on land with soil of high farming quality. Those opposing the development argued that allowing development would not sustain the life supporting capacity of the soil. This was rejected from the perspective that protecting high value soils does not ensure sustainability if it deprives future generations of the ability to live in an expanded community.

Critical thinking questions: Do you think that a see saw approach necessarily brings a weaker commitment to environmental protection than a hurdle approach? What information and environmental data would be needed to follow the hurdle approach compared with the see saw approach?

The key themes of the legislation are the 'sustainable management' of natural and physical resources, the integrated management of resources and the control of the adverse effects of activities on the environment (Williams 1997: 68). The definition of sustainable management was influenced by the Brundtland Report (World Commission on Environment and Development 1987) but differed in reducing the obligation to consider the needs of future generations to 'reasonably foreseeable needs' (Banks 1992). Whereas Brundtland implies that equity and distributional issues are to be considered (see Barkemeyer et al. 2011). The Resource Management Act focuses on managing the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic and cultural wellbeing and for their health and safety while:

- sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations;
- safeguarding the life supporting capacity of air, water, soil and ecosystems; and
- avoiding, remedying, or mitigating any adverse effects on the environment.

Beyond resource sustainability, 'matters of national importance' to be taken into account relate to protecting the quality of the natural environment, the maintenance and enhancement of public access to and along the coast, lakes and rivers and to the recognition of Māori values.

The Act set out a hierarchy of policy statements and plans whose function is to define an 'environmental bottom line' and provide decision makers adjudicating development proposals in different regions with a common understanding (Fig. 3.1). Central government is empowered to make national policy statements and environmental standards, with the Ministry for the Environment and the Ministry of Health principally undertaking the task. Guidelines contain recommendations for the attainment of environmental quality in a specific area (such as the management of the

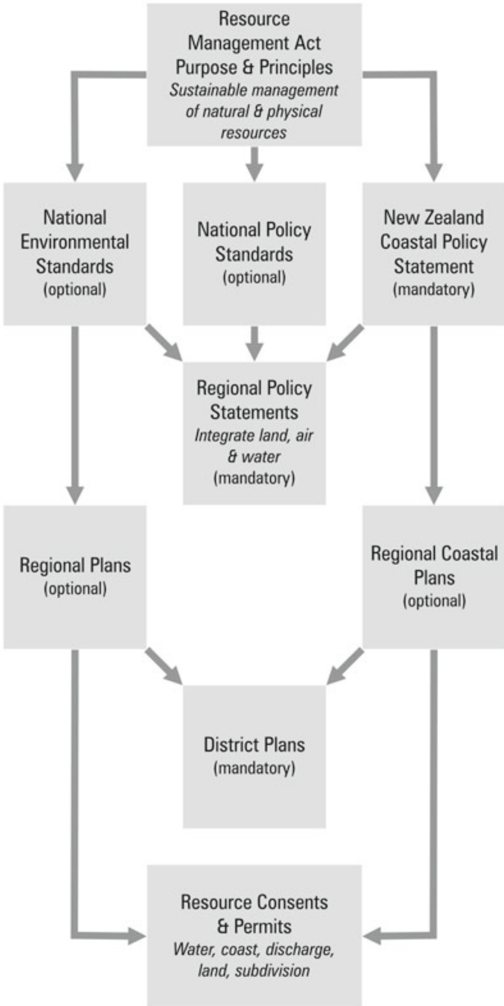

Fig. 3.1 Hierarchy of responsibilities under the Resource Management Act

coastal zone or minimum ambient air quality to protect health). In the past, regulations typically specified the technology to be used or the level of discharge permitted. Under the Resource Management Act, regulations are expected to specify desired environmental conditions so that individual actions can be judged in terms of their impact on sustaining the target conditions (OECD 1996: 96). They may also identify incentives and ways for resource managers to achieve the targets and methods for measuring progress. Guidelines are not legally enforceable but they may become so if incorporated in a policy or plan produced by a local authority. By early 2007, guidelines had been released by the Ministry for the Environment relating to five environmental issues.

Table 3.3 Status of national resource management policy instruments 2010

National instrument	Year work commenced	Status in 2010
National policy statement		
NZ Coastal policy statement	First statement 1991; second statement 2008	Second policy statement published 2010
Indigenous biodiversity	2000	Under development
Electricity transmission	2004	Introduced 2008
Renewable energy generation	2005	Under development
Freshwater management	2006	Under development
Flood risk management	2007	On hold
Urban design	2008	On hold
National environmental standards		
Air quality	2003	Introduced 2005
Sources of human drinking water	2005	Introduced 2007
Telecommunications facilities	2005	Introduced 2007
Electricity transmission	2005	Introduced 2010
Water measuring devices	2005	Introduced 2010
Contaminated sites	2006	Under development
On site wastewater	2007	Withdrawn
Sea level rise	2008	On hold

Source: Ministry for the Environment (2010: 29–30)

- Air quality: guidance for councils and industries to improve quality and consistency in monitoring and managing of air quality.
- Transport: guidance on the collection, analysis and use of four environmental indicators for transport.
- Water quality and environments: guidance to assist council's judge whether water is suitable for recreational use from a public health perspective.
- Kaimoana (seafood): guidelines to assist hapu and iwi design a survey of their kaimoana resources.
- Cultural Health Index: a tool for Māori to assess and manage waterways in their area.

Standards differ from guidelines in being legally enforceable and having national application (Ministry for the Environment 1995). The first national environmental standards were not introduced until October 2004 by which time there was mounting criticism of the lack of direction for local authorities (Ericksen et al. 2003: 70). The first standard actually comprised 14 separate standards aimed at preventing toxic emissions and protecting air quality (see Chap. 8). By 2010 standards had been introduced for three other areas of environmental concern which are mainly the product of priorities set following amendments to the Act in 2005 (Table 3.3).

- National environmental standard for human drinking water sources. This standard requires regional councils to consider the effects of activities on drinking water sources in their decision making relating to resource consents, discharge or water permits.

- Electricity transmission: the standard defines minor activities that can be undertaken without a resource consent to maintain the national grid (such as painting a pylon). Related standards may be proposed to identify activities in the vicinity of the transmission network that need to be controlled and to manage low frequency electric magnetic fields associated with electricity transmission.
- Telecommunications facilities: standards to control radiofrequency exposure and to specific telecommunications facilities are being investigated by an industry-led reference group.

Four standards were at various stages of development in mid-2011, ranging from initiating consultation to being legally drafted. These standards deal with contaminants in soil, ecological flows and water levels, future sea-level rise and plantation forestry. That concerned with ecological flows and water levels aims to promote consistency in the way the variability and quantity of water flowing in rivers, ground water systems, lakes and wetlands is deemed to be sufficient. That dealing with plantation forestry addresses the consistency of local authority plan rules that might apply to plantation forestry activities (afforestation, replanting, mechanical land preparation, harvesting, pruning and thinning to waste, earthworks, quarrying and river crossings) and erosion management requirements.

As well as the ability to give national direction through standards and policy statements, the Resource Management Act specified call-in procedures for projects of national significance, including proposals affecting rights under the Treaty of Waitangi. The use of call-in powers was intended to be unusual but use grew particularly in response to a need for energy generation. For example, an application for an air discharge permit in conjunction with a planned new power station at Stratford, Taranaki was called-in because it was deemed that the acceptability of the potential carbon dioxide emissions was not appropriately determined at the regional level (OECD 1996: 129–30). Subsequently, concern grew that the Act's emphasis on local decision making was stifling energy projects and the balance needed to be adjusted in favour of national-level assessment.

Other than when cases are called-in, regional councils are expected to provide 'integrated management of the natural and physical resources of the region'. Each council is required to prepare a Regional Policy Statement identifying environmental issues and responses of significance for its region. A Regional Coastal Plan is also mandated (all New Zealand regions have coastal areas) and there is discretion to prepare other regional plans. As well, regional councils have the task of granting resource consents relating to those activities potentially encompassed by their plans: coastal development; activity in river beds; the use of natural water; and land based development where there are impacts for soil conservation, hazard mitigation and the quantity and quality of natural water.

Below regional councils, territorial authorities are charged with achieving 'integrated management of the effects of the use, development, or protection of land and associated natural and physical resources of the district'. They are required to make district plans to manage environmental issues arising from land use and are responsible for resource consents for developments within the scope of their plans.

The Act specifies requirements for councils to consult relevant government agencies, iwi and other stakeholders. These obligations apply throughout the plan making process to encompass not only the objectives and policies but also the methods and rules to be adopted in the plans. The obligation to involve Māori is broader than for other parties. The Act specifies the need to observe the principles of the Treaty of Waitangi and the onus is on councils to ensure that this takes place rather than on resource consent applicants (Williams 1997: 90). There has since been much discussion on what constitutes effective consultation with Māori and how it might be obtained (Box 3.6).

Box 3.6 Case Study: Consulting Māori (Source: Ministry for the Environment 2003; OECD 2007)

Consultation with Māori, or more precisely with tangata whenua (the iwi or hapu that holds mana whenua or customary authority over the area affected by a proposal) is required under the Resource Management Act to recognise the rights of Māori under the Treaty of Waitangi. As a partner to the Treaty, tangata whenua have a right to be consulted as well as it being an obligation for the purposes of obtaining appropriate and accurate information on potential environmental effects. These purposes recognise that a special cultural relationship can exist between Māori and natural resources and that this needs to be part of an informed decision. The Act further specifies that all persons exercising powers under it shall have particular regard to kaitiakitanga, the guardianship of natural and physical resources in accordance with Tikanga Māori (Māori customary values and pract ices).

Expected consultation practices have been recommended such as ensuring adequate information on a proposal is given in a timely manner so that those consulted know what is proposed. People must be given a reasonable opportunity to state their views and there should be meaningful dialogue conducted in a fair manner. Payments in return for consultation have become common from local authorities as well as resource consent applicants. The Environment Court has determined that this is not improper provided that the payment is related to costs of the party being consulted. In turn, iwi have now often set up committees to deal with resource consent applications and other local council issues. In 2004, all 16 regional councils had formal processes for consulting with Māori compared with 3 in 1997 with 11 councils also maintaining informal processes. Nearly two thirds of district councils reported likewise. Key issues arising for Māori include being consulted too late in the decision making process, lack understanding of Māori issues among government officials leads to their concerns being ignored and that consultation procedures can be too extended.

Critical thinking question: Can special consultation procedures in themselves address the concerns that Māori express with their ability to participate in the management of environmental resources?

Increased provision for public participation in resource consent decisions was a significant aspect of the Resource Management Act (Fookes 2000). An assessment of the effects of development proposals must accompany resource consent applications, including:

- identification of the persons interested in or affected by the proposal;
- the consultation undertaken;
- any response to the views of those consulted.

If the adverse effect on the environment is minor and written approval has been obtained from every person who may be affected by the granting of the consent, further notification may not be required. Otherwise applications are ‘notified’.

Notification means sending the application to persons who the consent authority believes to be affected and publishing a notice in a newspaper. In a significant extension of the right to participate in decision making, in the case of notified resource consents any person could to make a submission (and may choose to do this at a local authority hearing) and then subsequently appeal the decision made on the application.

Consent authorities may drop notification requirements where they are satisfied that everyone potentially affected has given their agreement for the development. Concerns have been raised that this provision encourages a market for resource consents (Gleeson 2000). Notification and participation can extend the time taken for resource consent decisions and add uncertainty for the developer. This may make them willing to negotiate a mutually agreeable outcome, possibly including payment for the consent of affected parties which may include the Department of Conservation.

Overall, while the Act has facilitated participation from motivated individuals and groups it does not appear to have increased the motivation to get involved (Ericksen et al. 2003). From the outset there has been concern that community groups are disadvantaged by their lack of resources to hire expert witnesses to present a case or to fund public relations campaigns (Ong 2000). They must also contemplate having legal costs awarded against them when their challenge to a resource consent decision is unsuccessful; although legal opinion is that the award of costs is less likely for environmental cases than in other areas of jurisdiction (Williams 1997: 172). Appellants must be judged to have needlessly put successful parties to expense by not having a seriously arguable case (Young 2001: 76).

An environmental legal aid scheme was to have been introduced alongside the Act to help community groups participate in legal proceedings but did not eventuate. The Environmental Legal Assistance Fund was introduced after the 1999 election as one of the Green Party’s conditions for supporting the Labour-led government (Young 2001: 75). In 2010, the Fund supported environmental, community, iwi and hapu groups up to NZ $40,000 per applicant. The funds are allocated competitively with the priority being significant cases where:

- the matter before the court is of environmental public interest;
- the focus of the case is the protection or enhancement of environmental qualities;

- the case affects the wider community or general public;
- a lack of financial resources seems likely to result in an imbalance in the ability to present a case.

The commitment of the group and the resources they can contribute, previous experience in legal cases, openness to mediation and any financial interest in the outcome are also considered. In addition to case specific support, the Community Environment Fund (CEF) provides funding to support practical environmental initiatives, community-based advice and education projects and projects designed to increase awareness of environmental legislation. The CEF replaced the Resource Management Act Education and Advisory Fund that had a remit to support legal advice to communities on resource management issues and activities to increase public understanding of the Act.

3.7.1 Judgments on the Resource Management Act

At the time of its introduction, the Resource Management Act could be considered 'a landmark achievement in providing a *basis* for more comprehensive and better integrated environmental policy' (Bührs and Bartlett 1993: 148–9). The assessment was qualified by caution that the actual impact would depend on the adequacy of the resources allocated for its implementation. As already noted, one assessment is that sufficient resources have not been allocated with a consequence that national policy direction has been inadequate and the quality of most regional and district plans is below what is needed (Ericksen et al. 2003). Similarly, based on discussions with the architects of the legislation, the Act's shortfall has been tied principally to the limited funding for the Ministry for the Environment (Young 2001: 56).

Without assistance and additional resources, administrators tended to adapt previous management approaches rather than embrace sustainable management. Under funding was exacerbated by a change in government. A right-of-centre government enacted the legislation and administered the Act for most of the 1990s without the same priority for environmental management as the left-of-centre government that had drafted the legislation (Ericksen et al. 2003). From 1999 to 2008, reversion to a left-of-centre government (including Green Party support) assisted by a period of economic expansion prior to the 2008 global financial crisis resulted in some redress of the resource shortcomings. Increased funding of the Ministry for the Environment came with direction to accelerate the production of national policy statements and guidelines. Subsequently, the Ministry argued that the lack of environmental data makes it hard to convince people of the need to develop national environmental standards (OECD 2007: 172).

There has been no comprehensive evaluation of the Act by the Parliamentary Commissioner for the Environment since it identified a number of short comings with its implementation (Parliamentary Commissioner for the Environment 2002: 140).

- Insufficient joint arrangements for managing issues and resources that straddle local authority boundaries.
- Inadequate integration of activity between regional councils and their constituent territorial authorities.
- The absence of national guidance to encourage a consistent approach among local authorities to the setting of environmental outcomes and the evaluation of environmental effects.
- Insufficient checks and balances and a lack of performance accountability for ensuring that responsibilities are carried out.
- Inadequate attention to and management of cumulative environmental effects.
- Low priority to monitoring and enforcement.

More recently, the Ministry for the Environment (2008) has noted areas where the Act is working well: the control of point-source pollution and in the low rate of appeals over resource consent decisions, suggesting it provides a means for adjudicating land use conflicts. It nonetheless saw a need for reform of the Act with the general aim of reducing the administrative burden, strengthening the role of central government and increasing enforcement powers. These concerns are partly shared by wider assessments of the Act and have informed subsequent amendments and proposals for further reform. Before considering the latest changes to the Act it is worth outlining the differing perspectives of those who see the Act as giving too little protection for the environment and those who see it as being too restrictive on the use of resources. As well, a Māori perspective on the Act can be distinguished focused on compliance with the Treaty of Waitangi.

3.7.1.1 Environmental Perspectives

An environmentalist perspective sees the Act as a product of a particular phase of public policy making in New Zealand (Young 2001; Parliamentary Commissioner for the Environment 2002: 94). It was designed at a time when government was reducing its involvement in many aspects of New Zealand's economy and society (the so-called Rogernomics or neoliberal revolution) as well as being influenced by the global debate on environmental sustainability. Environmentalists tend to see the Act as an unsatisfactory compromise between these divergent agendas and values. It focuses on controlling environmental 'effects' rather than prescribing how environmental 'bottom lines' are to be adhered to. Standards were to be developed to identify the environmental conditions to be attained but market forces are to be relied upon to create the most efficient use of the resources available. This implied that environmental standards could be developed separately from political and value considerations relating to how sustainable management is attained (Perkins and Thorns 2001). Recent discussions about New Zealand's energy needs are pointed to as one case where environmental needs rely on public sector intervention (Box 3.7).

Box 3.7 Case Study: Incorporating Energy Efficiency and Renewables in Resource Management

In reviewing the lack of progress on energy efficiency, the Parliamentary Commissioner for the Environment (2000) recommended that the Minister for the Environment give guidance to local authorities on how to balance landscape protection and the benefits of developing renewable energy sources such as wind power. At the time, it was judged that few local authorities gave any consideration to energy efficiency or the value of renewable energy when making decisions under the Resource Management Act. The Act required that particular regard must be given to the 'efficient use and development' of natural and physical resources but not the efficiency for energy generation. Consequently, only the direct environmental effects of energy developments were being considered. This gap was also drawn attention to by the 2001 Energy Efficiency and Conservation Strategy which recommended that the Resource Management Act be changed to allow energy efficiency and benefits of renewable energy to be given consideration in resource consent decisions. That was acted upon in 2003 as part of package of energy-related amendments to the Act.

Critical thinking questions: Should negative environmental impacts (such as the noise and visual intrusion of a wind farm) be judged against the resource efficiency gains from allowing new energy generation to replace older, relatively inefficient technology. Who is likely to gain and who is likely to lose from allowing this trade off?

The absence of a rigorous commitment to environmental sustainability is a related source of criticism (Wheen 2002). Three 'escape routes' have been identified that are seen to dissipate any guarantee of environmental protection.

- The purpose of the Act is to *promote* the sustainable management of resources. A weak interpretation is that this merely signifies that sustainability is an aspiration that it is desirable to strive for rather than a specific state that must be achieved (Wheen 1995).
- The definition of sustainable management permits a balancing test approach to resource decisions rather than setting a hurdle to be jumped and balancing tests are inherently biased toward development (Wheen 2002: 273). This bias exists because a minimum level of environmental quality is not specified in the legislation.
- A narrow obligation can be construed that it is merely necessary to control the effects of economic activities on the bio physical environment (Grundy 2000). A real commitment to sustainability, it is argued, requires a 'holistic' interpretation to consider how any changes in the level of equity in society and control of resources may affect outcomes for future generations.

It is widely agreed that the concept of sustainable management set out in the Act has been open to alternative interpretations (Young 2001). This may have been encouraged by linking the Act to sustainability when it was designed to address the environmental management part of sustainable development only (Parliamentary Commissioner for the Environment 2002: 160).

3.7.1.2 Business Perspectives

Those who view the Act as too restrictive on development allege that it has substantially increased the uncertainty and cost of gaining approval for projects. This perspective comes mainly from the business community and is in contrast to initial broad satisfaction with the Act (Dormer 1994). That satisfaction attached particularly to the non-notification provision and ability to negotiate directly with parties to circumvent notification. A number of areas of caution accompanied the endorsement: a perception that the cost of seeking resource consent was rising; a failure of councils to meet prescribed time frames and too little use of economic instruments.

Federated Farmers are one of several groups campaigning for changes to the Act. They believe environmental protection is given too much weight to the detriment of the viability of farming enterprises, particularly when it relates to judgmental attributes such as views and landscape. A lack of practical farming knowledge among local government officers and their advisors is thought to exist. These concerns might arise under any environmental management regime but other concerns are specific to the Resource Management Act.

- Councils use section 92 of the Act to make further information requests of resources consent applicants to disguise their failure to process applications within required timeframes rather than because of actual information gaps.
- Overly constrictive land use decisions are made because plans are based on generalised perceptions of activities rather than actual assessments of the effects of those activities.
- The Act gives voice to environmental groups from outside the community affected by the plan or development proposal that are led by individuals acting without a clear mandate from those they claim to represent and that receive funding from the Environment Legal Assistance Fund.
- Councils are too restrictive in what they accept as ‘expert’ advice as compared with the opinion of a lay person.
- Section 32 requires that councils justify decisions but often there is little or no use of analysis that identifies the costs and benefits of the decisions taken.
- The turnover of staff dealing with consent applications that take a long time to evaluate, plan variations and communications with submitters increases cost to the applicants.
- The Department of Conservation is required to be consulted on applications for resource consent that raise issues for conservation as well as being free to participate in plan making and development decisions as an advocate for conservation.

As a publicly funded agency, it is alleged to give too little attention to the impact of its intervention on the time and cost of the decision making process.

The Parliamentary Commissioner for the Environment (2002: 95) has commented that criticism of the Act is voiced so frequently that a negative view exists whatever the real situation. In reality there is evidence to counter some of the criticism. New Zealand's environmental regulatory costs have been estimated as being 26% of total regulatory costs which is close to that typical of other OECD countries (OECD 2001b). The government's Ministerial Panel on Business Appliance Costs concluded that many of the problems business experience with the Act result from the way councils, resource users and applicants operate rather than from the law itself. From a peak of around 3,000 cases in 2000, the number of cases awaiting the attention of the Environment Court had halved by the end of 2004. Approximately 1,000 cases are still being appealed to the Environment Court each year but decisions on most cases are now made within months (see Registrar of the Environment Court 2010). Of course, while the overall performance may improve it can be that the efficiency with which particular resource consent applications are dealt with has most influence on the perceived performance of the Act.

3.7.1.3 Māori Perspectives

The Resource Management Act specifies a need to recognise and provide for Māori culture and traditions and to make active steps to ensure resource management occurs in partnership with Māori. The special status given Māori is recognised through specific clauses in the Act specifying their entitlements and obligations on the wider community to recognise these entitlements. Despite this Māori evaluations of the Resource Management Act tend to argue that they have gained little from it (Matunga 1997, 2000; Keenan 2002). One reason for this judgment is that the ownership rather than management of resources is an overriding consideration for Māori (Hayward 1999). The ownership of resources is not addressed in the Resource Management Act but is left to the Waitangi Tribunal and settlements negotiated between the government and Māori claimants. A perceived failure of statutory agencies to engage in dialogue with Māori when they are preparing plans and considering resource consent applications is a further source of criticism. This criticism has been supported by others including the Parliamentary Commissioner for the Environment (1998a). One assessment from a Māori perspective thus identifies four key shortcomings of the Act (Matunga 1997: 111).

- It does not recognise iwi as a legitimate resource authority in the way that it recognises regional councils and territorial local authorities as primary resource managers.
- It does not attempt to grapple with the concept of rangatiratanga (the right of Māori to self-management of their resources) and what it may actually mean for resource management.

- It does not give any positive direction to regional councils and territorial local authorities as to their obligations under the Treaty of Waitangi, rather these agencies are left to 'find their own way'.
- It lacks a mechanism for ensuring that iwi or hapu resource management plans are adequately integrated with other policies and plans required by the Act.

The Parliamentary Commissioner for the Environment (2002: 156) has acknowledged these concerns but notes that the appointment of Māori liaison officers or advisory groups by local authorities is a positive initiative. The Waitangi Tribunal in its judgement on the Wai 262 claim (see Chap. 5) has seen that there is still need for more concerted efforts by local authorities to involve Māori in resource management (Waitangi Tribunal 2011). It suggested that for the Resource Management Act to be seen as supporting Māori culture, engagement between tangata whenua and local authorities needed to become compulsory, formal, and proactive. The Tribunal also recommended greater use of national policy statements to guide local authorities over the involvement of Māori in decision-making.

3.7.2 Reforms of the Resource Management Act

By 2008 the Resource Management Act had been amended on at least 13 occasions (Ministry for the Environment 2008: 21). Subsequent to a change in government in that year, there was a further amendment in 2009 and proposals released that envisaged further reform (Ministry for the Environment 2010).

The 2005 and 2009 reforms were made largely in response to compliance concerns but were indicative of two differing assessments of the nature of the compliance problem. The 2005 reform acknowledged local authority complaints that the central government was not providing sufficient guidance on what sustainable development entails (OECD 2007). Intentions for central government to accelerate the production of national policy statements and national environmental standards were announced. In the case of large or complex projects, such as energy developments, local authorities would be able to seek additional resources from Government or even ask the Environment Minister to 'call in' the project. Government committed to provide councils with more information to assist their consultation with iwi authorities and to encourage iwi participation. As well, steps to streamline the plan-making and consent processes were announced. The Environment Court, for example, was directed to have regard to local consent authority decisions and to focus only on matters in contention, rather than starting the whole process over again. Training of decision-makers was to be enhanced and linked to an accreditation system.

The 2009 changes went further than the earlier reforms in seeking to speed up the resource consent process. This was facilitated by the decision to establish the EPA to focus on environmental policy implementation in matters of national interest. Applications for resource consent may now be made directly with the EPA. Applicants were also given the ability to refer potentially contentious applications directly to the Environment Court to by-pass the local authority hearing and decision stages. At the same time, local authorities were put under pressure to process quickly the resource consent applications they still receive: a requirement to discount administration fees when consent approvals are processed late now exists. The related concerns about the Resource Management Act facilitating frivolous objections and appeals, sometimes motivated by attempts to block competitors rather than a concern with environmental impacts, was addressed in four ways: (i) the ability to impose court costs on an objector judged to be engaging in anti-competitive behavior; (ii) narrowing of the range of third parties able to join Environment Court proceedings; (iii) explicit restrictions on trade competitor interventions; (iv) less ability to claim representation of the 'public interest' as a basis for process for participating in the appeal process.

The Parliamentary Commissioner for the Environment (2009) endorsed the intention to streamline and simplify the Act and welcomed the setting up of the EPA as an opportunity to inject additional expertise into environmental management. Two aspects of the reforms were questioned. First, it was noted that limiting the ability of consent authorities to make repeated requests for information from consent applicants (allegedly sometimes done to disguise a failure to process applications on time) might have the unintended consequence of increasing the information requested at the times that remained for local authorities to make information requests. Second, it was considered important to retain a right for citizens to appeal against the adoption of council plans on matters of content as well as points of law. Here the Commissioner was responding partly to concerns that district plans sometimes give inadequate attention to protecting environmental quality from the cumulative impact of individual developments (as provided for in Part 2 of the Act).

In 2010 the Ministry for the Environment published further proposals for change but this time targeted on the provisions of the Resource Management Act as they affected urban infrastructure and planning. These proposals responded partly to the reform of local government in the Auckland region. With the creation of the 'super city' there is a belief that this is an opportunity to encourage the region's economic growth but that this will depend on an efficient process for approving new infrastructure development. Further discussion of this is given in Chap. 9.

3.8 Participation in International Environmental Agreements

The making of environmental policy is more than a national activity. Many environmental problems have no political boundaries and need international collective action to be dealt with effectively. As a small country, New Zealand's contribution to global environmental issues can be small in absolute terms but this may not lessen its obligation to act. Among the main international and regional agreements reported by the OECD in 2007, New Zealand had ratified 55 international agreements (including the original agreements and subsequent protocols and amendments) and 17 regional agreements (OECD 2007: tables II.A and II.B). This level of participation was not far short of Australia. Measured per head of population, New Zealand can contribute more than the global average to shared environmental problems and this has been one justification for joining international agreements such as the UN Framework Convention on Climate Change (Bührs and Bartlett 1993: 148–9). The vulnerability of Pacific Island communities to environmental change is also a motivating factor. New Zealand has a large population of migrants from the Pacific and stands to be affected by environmental disasters affecting Pacific Islands. It is also a major source country for tourists to Pacific Islands. New Zealand's high dependency on international trade is another encouragement for New Zealand to support the international harmonisation of environmental management. There are also environmental issues that New Zealand has developed particular attachment to, such as the protection of whales and Antarctica where it claims sovereignty over the Ross Dependency.

The Convention for the Prohibition of Fishing with Long Drift Nets in the South Pacific 1989 is the international agreement that New Zealand has had most influence over. The Pacific's fisheries resources (and in particular the southern albacore) had been massively depleted by extensive fishing, principally by Korean and Japanese owned fishing fleets. With concern about the impact on the marine environment and the region's indigenous people, New Zealand played a key role in designing and gaining support for the convention that banned the use of drift nets over 2.5 m long from use in the South Pacific. This paved the way for a global moratorium on drift net fishing on the high seas agreed by the United Nations in 1991 (Ministry for the Environment 1997).

New Zealand can also claim to have been at the forefront of efforts to preserve the ozone layer in the earth's atmosphere (OECD 1996). This is not surprising as New Zealand lies below one of the thinnest parts of the ozone layer with significant health risks existing from further ozone depletion (Sturman and Tapper 1996). Less successful was New Zealand's advocacy of an Antarctic mining prohibition and environmental protection against the greater weight of international support for the moratorium agreed in the 1991 Madrid Protocol to the Antarctic Treaty on Environment Protection (Young 2004). This outcome nonetheless represents an environmental gain on New Zealand's attempts in the 1980s to promote a minerals convention that would have allowed limited mining activity of Antarctic resources.

In their most recent evaluation of New Zealand's environmental performance, the OECD (2007: 192) noted an improvement in the country's contribution to international conventions related to marine issues and that it has worked to promote international cooperation for the conservation of biodiversity and seabirds. During the 1990s, action was taken on some aspects of marine pollution as recommended by an earlier OECD (1996) review. The oil industry was required to increase its spill containment capacity and in 1998 New Zealand ratified the Convention on the Prevention of Pollution from Ships (MARPOL).

The same OECD evaluation judged that border surveillance to meet CITES obligations (the Convention on International Trade in Endangered Species of Wild Flora and Fauna) is judged strong but fines and sanctions imposed on transgressors were considered too low a deterrent. In the early 2000s, from 4,000 to 5,000 seizures by border control staff of CITES protected species or materials were reported annually. Other gaps were identified in terms of the implementation of a comprehensive package of climate change policy measures to ensure New Zealand attained its commitment to the Kyoto Protocol. Slow progress in the development of a national ocean policy commensurate with New Zealand's responsibility to manage the world sixth largest exclusive economic zone (EEZ) was also noted by the OECD. In 1996, New Zealand ratified the UN Law of the Sea Convention (UNCLOS) but was criticised by environmentalists for the absence of a comprehensive marine conservation strategy (Wallace 1997). In 2006, New Zealand filed a claim under UNCLOS to further extend its marine territory by 1.7 million km^2 so as to gain exclusive rights to the undersea resources. As discussed in Chap. 7, the EEZ is not covered by the Resource Management Act as it applies only up to the 12 nautical mile limit and hence the OECD concern with New Zealand's participation in international marine conventions.

3.9 Conclusion

New Zealand can claim to have increased the integration of its environmental management and decentralised much of the responsibility for implementing environmental policy and planning. The status of environmental management has advanced from the 1980s when the purpose of environmental management was confused, public agencies lacked policy coordination and opportunities for community participation were constrained. The Resource Management Act is mainly credited with bringing this change in status. There is also much agreement that this Act has further potential to strengthen environmental management. Various evaluations have pointed to the information hungriness of the Resource Management Act if it is to work as intended. In practice, much of the required information in terms of national policy statements and environmental standards has been slow to emerge. The Act has been in force since 1991 but only after 2000 have the necessary national strategies for particular environmental resources and issues started to be released. Similar judgments have also been made with respect of the adequacy of other guidance and training from central government that was needed by local authorities.

Beyond resource issues, three gaps in the environmental management system exist. First, there is no national urban environment agency despite the majority of New Zealanders being resident in cities. Such an agency could help by developing guidance on improving the efficiency of resource use, reducing waste and the integration of environmental, economic and social issues. New Zealand has made few gains in terms of the quality of the urban environment and the lessening of the impact of urban populations on the larger environment (Parliamentary Commissioner for the Environment 1998b). Such evidence and the need for an agency to enhance the sustainability of urban communities are given further consideration in Chap. 9.

A second institutional and regulatory gap is in the relative lack of attention to the marine environment. There is no agency that has responsibility for the sea as an ecosystem or that can influence the relationships between the marine, air and land environments (Wallace 1997). The OECD (1996: 169) has seen a need for greater visibility and involvement of the Ministry for the Environment on issues such as marine pollution. Whereas environment management of the land has been strengthened, little has changed for the marine environment since the Parliamentary Commissioner for the Environment (2002: 141) called for action. Especially for marine matters beyond the 12 mile limit, a multiplicity of agencies and Acts apply with no lead agency existing to coordinate their impact. The need to address this and policy proposals that have emerged are discussed in Chap. 7.

A third area of weakness concerns the allocation of natural resources. In particular there is increasing evidence of the poor condition of many of the country's waterways and increasing competition for freshwater in the rural economy. The issue is partly the limited ability of the environmental management system to control the intensification of agricultural activity where the environmental impacts are experienced cumulatively, over time. Adjustment from a regime based on capturing and allocating readily accessible water to one demanding more storage and distribution infrastructure and the need for more sophisticated allocation mechanisms to manage the distribution of extraction rights are other challenges to which the existing environmental management system has not responded well. The Ministry for the Environment (2008: 12) has identified inertia at local and central government levels as well as a lack of capacity to obtain scientific evidence to support decision making as underlying problems. It also points to delays in national policy development as arising from the need to address Māori rights and interests in water. Chapter 6 provides discussion of new initiatives to improve the management of freshwater resources.

A further area of concern is the weakness of the information base. As noted by the OECD (2007: 26), consistent environmental indicators and trend data that can be aggregated nationally are scarce. The Parliamentary Commissioner for the Environment (2007) similarly identifies the absence of environmental reporting as a fundamental challenge to improving the effectiveness of environmental management. The next chapter gives more attention to this issue as part of a review of environmental indicators.

Study Guide

End of Chapter Summary

3.1 Reforms of environmental agencies and regulation during the late 1980s and early 1990s form the basis of New Zealand's approach to environmental management.

3.2 The Ministry for the Environment and the Department of Conservation are the two most important central government environmental agencies. The Ministry for the Environment makes environmental policy and the Department of Conservation manages environmental resources as well as sites of historic and cultural significance.
3.3 Local government has the front line responsibility for managing the use of the environment, with regional councils coordinating input from their territorial authorities.
3.4 Non government agencies continue to be important influences campaigning for stronger environmental laws although there is now greater scope for influencing environmental policy through participation processes than in the past.
3.5 Māori influence over the environment is being extended through the Treaty settlement process and by legal requirements to recognise and provide for Māori culture and traditions and to make active steps to ensure resource management occurs in partnership with Māori. Iwi management plans are one way that Māori have expressed their perspective on resource management.
3.6 The Resource Management Act is the main law controlling the use of the environment. It aims to control the impact of activities on the environment with regional council decision making guided by national guidelines and standards. The Act remains highly controversial and has been affected by numerous amendments.
3.7 New Zealand is a signatory to many international environmental agreements and has been especially active in agreements to protect Pacific fishing and safeguard Antarctica from mining.
3.8 Three gaps in New Zealand's environmental management system are the absence of a national urban environment agency, a relative lack of attention to the marine environment and a failure to manage the allocation of natural resources in line with changes in demand.

Discussion Questions

What opportunities do you identify for the greater use of environmental charges within the environmental management system?

What, if anything, do you think needs changing with the Resource Management Act?

Select a recent issue on which the Parliamentary Commissioner for the Environment has made recommendations – for example waste management, water quality or sustainable farming – and search for evidence of recommendations being acted upon. What do you conclude about the importance of Parliamentary Commissioner's office?

The Resource Management Act is limited to addressing the environmental management part of sustainable development. Explain whether or not you think this focus is appropriate.

What are the benefits and risks of allowing developers to negotiate with affected parties so as to avoid notification? Do you think the benefits outweigh the risks or that the risks outweigh the benefits?

Do you think iwi management plans should be required to conform to specified standards before resource consent authorities are obliged to take note of their content?

Given that a representative cross section of the public does not take up participation opportunities, should public participation be continued with?

Do you think that the Environment Legal Assistance Fund helps the Resource Management Act achieve its objectives?

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Chapter 4
Principles and Indicators

Key Questions

- What are the main principles that have been proposed to guide environmental management?
- Do the shortcomings of environmental management principles make it futile to propose principles?
- What are environmental indicators and how are they useful?
- What are the main components of the pressure-state-response model?
- How successful are composite indicators such as the EPI at monitoring overall environmental performance?
- What do ecological footprints measure?

Abstract Principles that are based upon strong evidence can help guide effective action. Sustainability, precaution and polluter pays are often presented as principles of environmental management but their meaning remains too imprecise for them to provide sufficient guidance to environmental managers. Much difference remains as to what constitutes a contribution to sustainability and what a precautionary approach to environmental management implies. In the absence of certainty as to what actions to pursue, it is important to learn from experience and be adaptable as environmental conditions change. Environmental indicators assist through providing insight into the state of the environment and how this is affected by changes in population and economic activity. Ideally, an environmental indicator quantifies and thus simplifies environmental phenomena or systems and tells us something about changes taking place. Indicators can be combined into overall index scores to compare environmental performance between places but many measurement problems remain with the construction of composite scores.

Key Concepts and Terms Composite indicators • Ecological footprint • Environmental Performance Index • Environmental indicators • Headline scores • Indicators

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of environmental pressure • Polluter pays • Precautionary principle • Pressure-State-Response model • Pressure indicators • Principles of environmental management • State of the environment indicators • Societal response indicators • Sustainable Yield • Sustainability

4.1 Principles of Environment Management

Progress in the management of New Zealand's diverse ecosystems can be judged partly in terms of the extent to which management objectives are keeping pace with changes in social and economic expectations. As noted in Chap. 1, increasing expectations that environmental challenges are addressed is one of the defining features of the new environmentalism. The perceived ability to combine continued economic growth with the resolution of threats to the quality of the environment is encouraged partly by the extent to which new principles of environmental management appear to endorse this possibility. In this context, it may be judged significant that the Ministry for the Environment claimed that adherence to a core set of principles was one of the distinguishing features of New Zealand's new approach to environmental management (see Chap. 3, Sect. 3.1.1). Attaching New Zealand to recognised and significant principles of environmental management can be seen as keeping pace with social and economic expectations and of adding purpose to individual interventions.

The principles in question – sustainability, precaution, polluter pays – attract wide support as substantial contributors to the strengthening of environmental management as they help to resolve how protection of the environment is to be balanced against the needs of economic development. Nonetheless questions can be asked about the implications of the claimed alignment, whether it actually occurred and whether environmental management would be strengthened by renewal of the claim. This section considers the first of these requirements as if the implications are not clear there is reason to question whether claiming adherence is a substantial or meaningful action. In this context, the main issue is in what sense, if at all, sustainability, precaution and polluter pays can be considered principles of environmental management.

At the outset it is helpful to be clear what the term 'principle' means as it can be applied with different implications for management practice. Much confusion is created when terms are used without being explicit as to the implication they carry. In this context it is helpful to follow the guidance provided by Thomas (2003) and to distinguish four meanings associated with the word principle and then consider in what sense the three terms can be considered principles.

One interpretation of a principle is that it encapsulates the fundamentals, foundations or basics of a particular area of activity. In this sense it covers the essentials or important things to be known about a topic. A second meaning of 'principles' carries the implication of acting ethically in the sense of being 'principled' rather than behaving in an 'unprincipled' way. Adapting Thomas (2003: 99), environmental management principles might, therefore, be understood as moral rules or a code of ethics to which managers should adhere. A third meaning of principle is as a scientific law or generalisation: a principle identifies the expected outcome of a particular action. The final meaning is as a set of rules, in which case following a principle of environmental management might be recommended so as to ensure that activity is effective.

The debate around environmental management principles is largely around the third and last of these four meanings: does the principle amount to some kind of scientific law, such that adhering to the principle ensures a certain, desired outcome, and whether the principle identifies a course of action that can ensure management is effective.

4.1.1 Sustainability

The Ministry for the Environment (1997) claimed sustainability to be one of the principles guiding the reform of environmental management. Not everyone who uses the term sustainability presents it as a principle while others such as Epstein (2008: 37) suggest that sustainability is an overarching term encapsulating multiple separate principles (Table 4.1). Others are critical of the term, seeing it as the byword of environmental working groups, the jingle of environmental activists and the jargon of development planners and academics.

The most widely understood version of sustainability is that given in the Brundtland Report (WCED 1987) whose definition of sustainable development includes: 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. This definition makes it a potential candidate for being accepted as an environmental management principle in the sense of it identifying a rule to be followed to ensure environmental and economic needs are balanced. The difficulty is that to be a rule there must be specific guidance on how the trade off between environmental and economic needs is to be made. There are different views as to whether there is sufficient understanding to be certain that a state of sustainability has been achieved or even that conditions have moved in that direction.

One interpretation of sustainability that predates the recent revival of interest in the term is as a principle to guide the harvesting of renewable resources. This is the idea of confining the use of a resource to the level that offers a sustainable yield so that exploitation of the resource does not endanger its ongoing availability. Considerations of environmental protection may or may not be specifically taken into account. Maximum sustainable yield (MSY) considers that an acceptable way to exploit a renewable resource is to extract or use as much of the resource as possible to the point at which the extraction rate equals the renewal rate. An example would be to remove water from a well by an amount which is equal to the replenishment of the water table by rainfall. Taking less would amount to underutilisation of the resource, while too much would lead to depletion of the resource and ultimately, exhaustion.

Table 4.1 Epstein's nine principles of sustainability

Principle	Indicators
Ethics	The company establishes, promotes, monitors, and maintains ethical standards and practices in dealings with all of the company stakeholders.
Governance	The company manages all of its resources conscientiously and effectively, recognizing the fiduciary duty of corporate boards and managers to focus on the interests of all company stakeholders.
Transparency	The company provides timely disclosure of information about its products, services, and activities, thus permitting stakeholders to make informed decisions.
Business relationships	The company engages in fair-trading practices with suppliers, distributors, and partners.
Financial returns	The company compensates providers of capital with a competitive return on investment and the protection of company assets.
Community involvement/ economic development	The company fosters a mutually beneficial relationship between the corporation and community in which it is sensitive to the culture, context, and needs of the community
Value of products and services	The company respects the needs, desires, and rights of its customers and strives to provide the highest levels of product and service values.
Employment practices	The company engages in human-resource management practices that promote personal and professional employee development, diversity, and empowerment.
Protection of the environment	The company strives to protect and restore the environment and promote sustainable development with products, processes, services, and other activities. Emissions of greenhouse gases and attainment of commitments under the United Nations Framework Convention on Climate Change and Kyoto Protocol.

Source: Epstein (2008)

MSY has been widely used in fisheries and wildlife management, whereby populations are harvested at a rate that matches the species' ability to replace its numbers. It can be argued that overpopulation results in overcrowding and a decline in the health and wellbeing of the population of as whole.

MSY may fail to take into account large environmental fluctuations, such as droughts, unexpected extreme cold or food shortages, or unexpected reduction in population size or the resource and thus its vulnerability to depletion or over utilisation. To account for this, optimum sustainable yield (OSY) is sometimes recommended as a preferred target. OSY describes an optimum rate of exploitation or use of a resource that ensures minimal collateral damage or effect on species or components of the habitat or ecosystem. Typically a recommended OSY is less than a recommended MSY.

Simply put, MSY and OSY are maximum harvests that can be sustained indefinitely. However, there are several problems as it may not be clear exactly what is being 'sustained', for whom and for how long. To know you have reached

MSY you have to go beyond it. The concept MSY was developed for single species or single issue management, but physical and social environments are made up of complex, integrated systems. Another problem is that it is impossible to accurately model resource stocks and replenishment rates, as ecosystems are not in a steady state of equilibrium. These and other problems are discussed in the chapters that follow.

The ‘three circles’ model is a popular way of attempting to bring specific meaning to the concept of sustainable development (Barkemeyer et al. 2011). This model separates the three spheres of economic, social and environmental considerations, referred to as the three pillars of sustainability, and has a parallel application to individual businesses in the form of the ‘triple bottom line’ (Elkington 1994). Both representations bring the message that sustainability requires attention to social and environmental conditions alongside economic. A limitation of this approach is that the implications vary considerably as to whether the expectation is merely to give attention to each sphere as compared with achieving a form of development that simultaneously optimises outcomes across the three spheres. This can be understood in relation to the contrast between two types of triple bottom line reporting.

The phrase ‘triple bottom line’ was coined in the mid 1990s to encourage companies to report on more than their economic performance (or financial ‘bottom line’). It was argued that ultimately a company’s financial performance would be affected by their environmental and social impacts and so these ought to be reported on too as part of the annual business accounting (Elkington 1997). Consequently, it was recommended that companies monitor and report on: (i) economic and financial aspects of their operations (costs, profit, taxes and so on); (ii) environmental aspects (resources consumed, emissions, volumes recycled and so on); and (iii) social aspects (investment in occupational health and safety programmes, staff remuneration, workplace diversity, accidents and related indicators). This aligns with the three spheres model of sustainability and gives a more complete understanding and measurement of a company’s performance than where traditional financial accounts alone are reported upon.

The limitation of such reporting is partly that while there are rules guiding what needs to be reported to judge the financial performance of a company the measurement of social and environmental performance is underdeveloped. This is being addressed by groups such as the Global Reporting Initiative as well as efforts by researchers to devise ways of reporting different components of performance (see Blowfield and Murray 2011). This includes a New Zealand attempt to promote the use of a quadruple bottom line (Luckman 2006). The dilemma is that while there is no agreed way of combining economic, social and environmental performance into a single aggregate score, separate reporting on each bottom line means that it is not possible to gauge whether the investment in social and environmental performance is adequate (Brignall 2002; Papmehl 2002). An integrated score that offset negative environmental and social impacts against financial income would have potential to show whether a business’s activities bring a net gain to society. For the present there is no way of doing this that would produce a score that is credible to all interested parties: it is neither possible to know what impacts to measure or how to cost them.

Another way of converting sustainability into a principle that has been popular is to recognise different grades of sustainability. This is reflected in the distinction that is made between weak and strong sustainability and which has been applied in official documents as well as other writing about sustainability (Parliamentary Commissioner for the Environment 2002; OECD 2005; Brueckner 2010). The usual way of distinguishing weak and strong sustainability is in what they imply for the conservation of natural resources.

Weak sustainability requires only that the total man-made and natural stock be maintained. All forms of capital are considered more or less substitutes for one another which means that no regard has to be given to the composition of the stock of capital. It assumes that degradation of one group of assets (environmental, social or economic) can be compensated for by improvements in another. Thus, weak sustainability neglects component parts and focuses on the whole. Most importantly, weak sustainability does not accept a need for immediate constraints on economic activity because of the existence of the need to work within ecological limits. Weak sustainability allows for the depletion or degradation of natural resources, so long as such depletion is offset by increases in the stocks of other forms of capital (for example, by investing royalties from depleting mineral reserves in factories).

Strong sustainability views economy and society as subsets of the environment rather than as entities with an independent existence. The reason for this is the special characteristics of natural environmental resources which cannot be supplied by other resources. Man-made capital such as machinery used in harvesting and processing timber, for example, is of no value in the absence of stocks of timber to harvest. Only by maintaining both natural and produced capital stocks intact can future livelihoods be guaranteed. Consequently, sustainably means not exceeding the capacity of the natural physical environment to provide for and absorb the effects of human activities. All forms of capital must be maintained intact independent of one another. It is assumed that different forms of capital are mainly complementary; that is, all forms are generally necessary for any single type of capital to be of value.

The presentation of a strong and weak form of sustainability suggests a spectrum of interpretations divided by differing degrees of priority to the environment and that starting weak may be a first step toward becoming strong. Such a presentation is favoured by those commencing with a weak version of sustainability as it helps bring a sense of significance to otherwise comparatively low level action. It may however be more realistic to think that two radically different targets are under discussion with no obvious progress between them. Thus weak sustainability can mean no change from current patterns of economic activity and environmental management, working with the assumption that environmental and social problems can be solved if the economy is sound (Pratt and Lowndes 2005: 131). Strong sustainability, on the other hand, has been expressed in terms that can be viewed as a principle for environmental management but one with drastic consequences for the organisation of economic activity (Box 4.1).

Box 4.1 Daly's Principles of Sustainability (Source: Daly 1990)

Sustainable development is different to sustainable growth. Growth implies a quantitative increase in physical scale. To develop implies qualitative improvement or an unfolding of potentialities. An economy can grow without developing or develop without growing, it can do both or do neither. Since the human economy is a subsystem of a finite global ecosystem, it cannot grow indefinitely. The term sustainable growth is therefore a bad oxymoron. Sustainable development of non growing systems is feasible if it adheres to a number of principles.

With respect to the use of renewable resources, harvest rates should be no higher than regeneration rates. The generation of waste emission rates should stay within the natural assimilative capacity of the ecosystems emitted into. Failure to respect regenerative and assimilative capacities results in capital consumption.

Manmade and natural capital should be viewed as complementary and not as substitutes for each other. For example, a house complements a tree: houses can make use of forest products but human society would not survive if all trees were converted to houses; oil refineries are not a substitute for depleted oil wells. As a consequence development is limited by the one in shortest supply, which now generally means natural capital.

Strictly nonrenewable resources cannot be maintained intact short of not using them. A quasi-sustainable use of nonrenewables requires that any exploitation of a nonrenewable resource is paired with a compensating investment in a renewable substitute (for example, oil extraction is paired with tree planting for wood alcohol). The consequence may be reduced consumption stream but the use of nonrenewable resources on this basis means income is for real because it is not obtained by depleting the future ability to earn an income. How close the pairing must be is not entirely clear except that two requirements must be met. It must ensure that the substitution is in a renewable resource that will be harvested sustainably and that this sufficient complementary natural capital. For example, use of coal must be linked to replenishment of energy resources and the capacity of the environment to absorb the by-products of burning coal.

Critical thinking question: How close to these principles of sustainable development are industrial economies today? What evidence would convince you that these principles should be adhered to?

The contrast between weak and strong sustainability is repeated in the presentation of sustainability as eco-efficiency or eco-effectiveness. The World Business Council for Sustainable Development (2000: 32) defines eco-efficiency as:

> Delivering competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout their life cycle, to a level at least in line with the earth's estimated carrying capacity.

In essence, eco-efficiency is about trying to produce goods and services while using less materials and energy and generating less waste per unit of output than previously. The limitation is that eco-efficiency affects the environmental impacts of individual goods and services but does not manage increases in consumption across an economy as a whole. Reductions in car emissions, for example, can be neutralized by increases in road traffic. This feedback mechanism has been labelled the 'rebound effect' (Dyllick and Hockerts 2002) or 'dilemma of the N curve' (Jänicke et al. 2000; Jänicke 2008).

Eco-effectiveness involves conscious striving to enhance environmental conditions by rethinking technologies, products and the whole relationship of business and society. It is a term associated with the ideas of McDonough and Braungart (2002, 2006) who advocate a fundamental rethinking of how products are designed so that increases in consumption can be accommodated without negative consequences for the environment. Their agenda is to promote the redesign of products so that they are based entirely on a combination of two types of material: (i) materials that are fully biocompatible such that they can be disposed of safely into the environment at the end of their useful life in a form that will support ongoing regeneration of ecosystems; (ii) 'technical nutrients' which can be taken back from products at the end of their life and reused with no loss of quality.

The tendency for debate around sustainability to lead to dramatically different development paths may also be seen when the Māori conception of sustainability is introduced too. Kaitiakitanga is a Māori idea of protecting the mauri (life principle) of taonga (valued resources) for sustainable use and management of natural resources. Kaitiakitanga involves the guardianship of natural resources and ecological systems in accordance with custom and tradition and defines the role of Māori to act as kaitiaki, the temporary guardians of the richness of all life and matter. In the kaitiakitanga world view, people do not own natural resources to exploit but are temporarily supported by Papatuanuku (Mother earth) to use and manage taonga. Kaitiakitanga might include restocking of pāua beds by the transfer of pāua from one area to another and the picking of harakeke (New Zealand flax, Phormium tenax) in a manner that ensures the conservation of harakeke for weaving and other practical uses (Wright et al. 1995; Kamira 2003).

Kaitiakitanga has some similarity to the Western idea of resources being harvested to their maximum sustainable yield, a concept that is applied in the management of fisheries and forests. The concepts differ in that maximum sustainable yield emphasises a purely functional use of resources. Kaitiakitanga includes a greater respect to the innate right to exist of the harvested resource and to cultural understandings of management responsibilities (Roberts et al. 1995). In this sense, while it is tempting to see parallels between Western and Māori approaches to sustainable development, the outlooks are frequently different. This has been partially recognised in the Resource Management Act (Chap. 3) which promotes adherence to 'sustainable management' and separately requires regard to kaitiakitanga.

Whether envisaged as weak or strong sustainability, the concept remains a long way from being an agreed principle of environmental management. One response acknowledges this but sees benefit in the way that openness to differing interpretations helps keep sustainable development on the policy agenda, or as expressed by O'Riordan (2000: 41) 'its very ambiguity enables it to transcend the tensions in its meaning'. Another response is to recognise that the speed with which the idea circulated after its use in the Brundtland Report was at the expense of the intent of the original issues to which it was intended to be addressed (Barkemeyer et al. 2011). Much of the emphasis in the Brundtland Report was on how patterns of development should be redirected to address 'the essential needs of the world's poor, to which overriding priority should be given' (WCED 1987: 43). This draws attention to the need to be concerned with the redistribution of wealth among existing populations and in redirecting effort towards alleviating poverty in low income countries. In contrast, sustainable development is most frequently interpreted as being about reducing the environmental impacts of business activity and consumption in high income economies. This restricted view of sustainable development fits with the pursuit of eco-efficiency and the goal of 'getting more from less'. The business community has responded to the challenge of doing this as there is sound commercial logic to becoming more resource efficient. This should not overlook that a broader development agenda is also intended to be addressed.

4.1.2 The Precautionary Principle

The precautionary principle is a general resource management guideline applicable to a decision-making process characterised by a considerable degree of uncertainty (Hussen 2004: 187). Applied to environmental issues, this principle indicates that society should avoid practices that have potential to severely diminish the options open to future generations even when there is not yet incontrovertible scientific proof that negative outcomes will actually ensue. In other words, it is appropriate to err on the side of caution if an action has potential for significant and irreversible damage to the environment.

Three sources of uncertainty that may justify caution have been identified (O'Riordan 2000: 21–22).

- Data shortages: understanding environmental processes often requires long term records but frequently these are missing. As well, large numbers of observations may be needed to measure environmental change. For example, how many recording stations are needed to measure the average temperature of the earth?
- Model deficiencies: environmental processes operate within ecological systems that link individual components together in complex ways. Making predictions about the impact of human behaviour requires these linkages to be put together in a model that can be used by scientists to identify how changes in one area will affect another. Scientific knowledge remains limited and so models give only a rough guide that leaves uncertainty about the impact of human action.
- Beyond the knowable: data collection and model building may improve but there may be some aspects of the environment that are beyond human capacity to

understand. This is partly the idea that environment systems are affected by chaos (random behaviour) and catastrophe (sudden, major shifts in environmental processes).

The precautionary principle can be contrasted with other decision rules that may be applied in conditions of information uncertainty when faced with potentially irreversible environmental harms. Other rules include zero risk, realistically achievable, no observable adverse effect, as low as reasonably achievable or leaving an adequate margin of safety.

From an economist's perspective the precautionary principle implies an approach to decision making that is different from using cost-benefit analysis. It is interpreted as requiring that decisions are based exclusively on consideration of avoided damages (benefits) for future generations (Hussen 2004: 187). There is no concern with the efficiency of decisions (does the expenditure to avoid damages bring at least an equivalent volume of benefits) rather the precautionary principle favours prudence over efficiency. Writing partly on the basis of experience in New Zealand, Moyle (2005) illustrates the dangers of this bias when applied to biodiversity management. Tasked with developing a management plan for Great Mercury Island, there was a need to devise a conservation strategy in the context of two sources of uncertainty: the actual condition of the island's ecosystem and the likelihood of different environmental states occurring. The precautionary approach was rejected in favour of two other principles to guide the island's conservation management: robustness and adaptability. Robustness considers how a particular strategy fares across a range of environmental conditions that may be faced. A robust strategy is identified on the basis that it offers a satisfactory outcome across a range of different conditions. Adaptability is indicated when a strategy is relatively easily adapted to take account of new knowledge that emerges through management experience. In the case of Great Mercury Island a strategy informed by the precautionary principle was rejected in favour of recommending an approach that was robust and adaptable.

Moyle (2005) argues that his experience on Great Mercury Island is indicative of the unsuitability of applying the precautionary principle to biodiversity issues. The principle, he argues, can have merit in an industrial context where there is only one potential source of harm: either a material with unknown but suspected hazardous impact is introduced or, when precaution is exercised it is not and the risk is avoided. With biodiversity management, the option of not accepting a management strategy because of precaution merely means accepting another management regime that brings another set of risks. For example, a decision to prohibit harvesting of a species because of a threat that over-harvesting may occur does not guarantee that the status quo prevails. A prohibition on harvesting may encourage illegal harvesting and there is still the possibility of environmental changes affecting the species population. From this perspective precaution alone cannot justify the selection of one management strategy over another. Options need to be assessed using additional criteria, including their robustness and adaptability.

The uniqueness of biodiversity management in challenging the use of the precautionary principle is questionable. The origins of the precautionary principle were in treaties to control the dumping of waste in the North Sea where there was an unproven but suspected link between dumping and fish health (Dethlefsen et al. 1993). Just as with biodiversity, stopping this potential risk did not preclude the possibility of the risk emerging elsewhere with potentially more devastating consequences. The industrial context perhaps offers some possibility of controlling such an outcome but any use of the precautionary principle needs to be tempered by some consideration of what the reaction to ceasing one activity may be. In this sense the limitation of the precautionary principle identified by Moyle (2005) can be addressed by recognising that use of the principle is sensitive to the framing of the question asked.

Applied to the issue of whether pesticides should be used to protect a particular crop, for example, precaution may produce an outcome that is different to that which would arise if the issue is expanded to include the effects on nutrition and health. Placed in this broader context, the environmental effects of pesticide use are potentially discounted by the environmental threats arising from crop failure, poverty and social collapse. The key issue is to expand the question frame to that which encompasses potentially connected actions so as to reduce the likelihood of a precautionary approach resulting in alternative courses of action that have adverse consequences (Sandin et al. 2002).

Before dismissing outright the potential of the precautionary principal to address a set of environmental issues, therefore, it is important to recognise that proponents see the principle more as work-in-progress than as something that is ready to be applied (Sandin et al. 2002). Sandin et al. (2002: 289) identify four dimensions to the precautionary principle when it is applied to policy choices: if there is (i) a threat, which is (ii) uncertain, then (iii) some kind of action (iv) is mandatory. These dimensions translate into a need to answer four questions.

1. To what types of hazard does the principle apply?
2. How much scientific uncertainty is required to evoke the principle (to recognise that there is rarely an absence of some degree of uncertainty)?
3. What types of measures against potential hazards does the principle refer to?
4. Are the recommended measures to be mandatory or is compliance voluntary?

A judgement about the value of the precautionary principle, therefore, depends partly on the confidence that such questions can be answered. Meanwhile, use of the principle continues to attract a wide range of interpretations. At the weakest level it can be taken to mean little more than ‘thoughtful action in advance of scientific proof’ or ‘leaving ecological space as room for ignorance’ (O’Riordan 2000: 23). This amounts to supporting the outlook that it is better to pay a little now than possibly a lot more at a later stage.

A strong interpretation of the principle views it as justification for shifting the burden of proof to the proponents of development and away from the community affected by the development. This is achieved by requiring developers to provide evidence that there will be no risk of adverse consequences from their actions, a burden of proof higher than that expected in the controls usually put of developers through means such as requirements to prepare environmental impact statements. Such an application is welcomed by those who wish to see a shift in the balance of power from the proponents of development to the community at large (O'Riordan 2000) but questioned by those who argue that allocation of costs for providing proof should influenced by the distribution of the benefits and ability to pay (Moyle 2005: 162).

Putting the precautionary principle in a larger context, it has been viewed as something to assist a redistribution of environmental responsibilities between high and low income economies. This is achieved by making the level of necessary precaution proportional to the ability of a country to take advance action and in proportion to the likely benefits obtained (O'Riordan 2000). In the case of low income countries, a low level of precaution may be justified by their overriding priority for development and capacity to administer environmental management controls. Recognising this absence of precaution, high income countries should accept a responsibility to be highly precautious.

4.1.3 The Polluter Pays

The polluter pays principle says that those who cause damage should stop the source of the damage or pay for the damage that they cause. Of the three principles, this one has influenced environmental management policy for longest. In 1972, the OECD published guiding principles for environmental policies that discussed the desirability of ensuring that the polluter should bear the expense of carrying out the measures decided by public authorities to ensure that the environment is maintained in an acceptable state (OECD 1972). This mechanism is designed to ensure that the true cost of producing goods and services is reflected in the price charged. As such, it is expected that all or at least some part of the increased cost of production will be passed on to consumers to influence their decisions.

Unlike the other two principles, the polluter pays idea is clear in its prescription but nonetheless it is no less difficult to put into practice.

- It is frequently difficult to identify the full extent of environment damage caused by an individual activity especially if impacts are diffuse, long term or affected by combination with other environmental impacts.
- Environment damage needs to be valued in monetary terms to identify the size of the bill that polluters might pay. Putting a price on the environment is difficult and some might argue inappropriate.
- Changing for environmental damage may not bring a change in behaviour, although the OECD (2001) do suggest that there is generally some impact over the long term.
- There is a risk of resistance to environmental regulation when a tax or charge is levied as it leads to suspicion that revenue generation rather than environmental management is the motive.

- For a small open economy such as New Zealand, environmental taxes may put exporters at a disadvantage in overseas markets if competitors from other countries do not face comparable charges.

There are different views on whether the polluter pays principle should be applied through environmental taxes and charges in New Zealand (see Chap. 3). Nonetheless, the polluter pays principle remains important because it conveys a simple message that has helped to focus attention on environmental management. More particularly, it has helped promote the idea that environmental regulation based on economic instruments can be 'business friendly'.

4.2 Monitoring the State of the Environment

An indicator is a component of a system that can be measured and used to assess whether things within the system are getting better or worse over time. Ideally, indictors simplify, quantify and communicate information that provides a reliable picture of trends and events. Environmental indicators are physical, chemical, biological or socio-economic parameters that represent key elements of environmental systems. Ideally, an environmental indicator quantifies and thus simplifies environmental phenomena or systems and tells us something about changes taking place. They have multiple uses that, over the long term, serve to gauge the relative success or failure of various approaches (policies, instruments and laws) for managing the environment. Because environmental indicators standardise and simplify information about the environment, they permit comparisons of countries and regions within countries. Of course, this assumes indicators are applicable to other communities and in other countries, which is not necessarily the case. In the best of circumstance, they assist policy makers and environmental managers to better understand the nature and severity of environmental problems. Information provided by environmental indicators can guide additional data collection. They facilitate analysis of causes of environmental problems and the environmental consequences of policy and institutional changes.

Some environmental indicators are tailor made to measure a particular type of human impact on the natural environment, to provide the statistics needed to monitor the trends in environmental change. For example, annual reporting of nitrate concentration in groundwater is an indicator of water quality. Another example is the rate of soil erosion as an indicator of environmental stability or a gauge of the performance of land use management practices. Another is the use and generation of toxic materials in industrial production. In other cases the indicator selected may be a compromise between that which ideally captures the environmental issue and that which it is practically possible to measure. A range of environmental indicators used in New Zealand's 2007 environmental monitoring report are given in Table 4.2. Of course, environmental indicators help decision makers understand why change is taking place only if they have a good understanding of the processes of change.

Table 4.2 Environmental indicators for 11 facets of the New Zealand setting

Facet	Environmental indicators
Air quality	Breaches of National Environmental Standards for air quality with potential to impact on human health.
Freshwater	Changes in water availability (surface and groundwater) and the proportion that is allocated through resource or other consents.
	Changes in national water quality that may impact on human health.
Climate change	Emissions of greenhouse gases and attainment of commitments under the United Nations Framework Convention on Climate Change and Kyoto Protocol.
Waste	Volume and composition of solid waste to landfill.
Contaminated land management	Change in the total number of contaminated sites that are either: (a) confirmed contaminated, (b) remediated or (c) discovered.
Land	Land cover and land use changes.
Ecological footprint	A sustainability indicator that shows the amount of land required to support the lifestyle choices of a given population.
Biodiversity	Population and distribution of selected native species.
	Proportion of land covered by indigenous vegetation and proportion protected for each environment identified in the Land Environment New Zealand classification.
Oceans	Extent of the Exclusive Economic Zone covered by marine protection areas.
	Percent fish stocks above the population needed to sustain an agreed level of catch.
Transport	Total vehicle kilometres travelled by vehicle type.
	Total consumer energy by use, by fuel type and by sector.
Consumption	Real household consumption expenditure for specific goods and service areas.

Source: Ministry for the Environment (2007)

4.2.1 Pressure-State-Response Framework

In the past, environmental indicators have generally been employed to gauge a specific environmental condition or variable, such as the nitrate concentration in groundwater mentioned above, or loss of habitat or particular species of animal of plant. However, it became apparent that while this might be directly linked to some particular change in the environment, it did not tell us what is causing the environmental damage or how we should deal with it. To get around this problem, three groups of environmental indicators are identified, namely, indicators of 'pressures' (P), 'state' (S) and 'responses' (R). They are linked all together in the OECD's so-called PSR framework (OECD 1993). Indicators of environmental *pressures* describe the pressures on the physical environment caused directly or indirectly by human activities, such energy use, transport, industry, agriculture and fishing. Indicators of the *state* of the environment relate to the quality of the environment and address the condition of the air, freshwater, coasts and coastal waters, land resources, biodiversity, human settlements, culture and heritage. Indicators of societal *response* show to what extent society is responding to environmental changes and concerns. The responses include such things as legislation, economic instruments, international obligations, new technologies, changing community values and others.

Extension of the PSR framework is possible to include driving forces before pressure and impact before responses. Driving forces encompass the underlying social, demographic and economic developments that create the direct environment pressures. Impact measures capture the effects that environmental changes have on environmental conditions and human health. The combined five indicators create the DPSIR model that was employed in New Zealand's 2007 state of the environment report (Ministry for the Environment 2007).

PSR indicators can be used to assess performance if a basis for comparison is clearly identified. For example, when a target or sustainability threshold is specified in setting environmental standards or policies, in which case they are referred to specifically as environmental performance indicators (EPIs). Environmental performance is usually assessed by comparing achievements or progress with: (i) national objectives; (ii) international commitments; and (iii) absolute levels of environmental quality, taking account of a country's physical, human and economic context. The OECD (1993) has proposed six key principles for the use of environmental indicators in environmental performance reviews.

First, indicators should provide just one of the tools in the process of performance evaluation and need to be supplemented by other qualitative and scientific information. Indicators are appealing because they are simple and to the point. But supplementary information is necessary to avoid the risk of misinterpretation. Such information is essential to explain why indictors change and to understand the significance of changes or trends. Second, there is no unique way normalising indicators for the comparison of environmental variables between across countries. Usually, normalisation is by unit of gross domestic product, population size or total surface area. The result can be quite different depending on which of these is chosen as denominator. Third, indicators must be reported and interpreted in the appropriate context, taking into account the ecological, geographical, social, economic and structural features of countries. Clearly, performance evaluation is relative to the overall physical, demographic, economic and administrative context of a country (Box 4.2). Fourth, not every area of assessment lends itself to the use of quantitative performance indicators. Certain policy areas may be better assessed in qualitative terms. Fifth, indicators of societal responses tend to be less advanced in conceptual and empirical terms than indicators of environmental pressures or indicators of environmental conditions. Thus, particular caution needs to be applied when interpreting and using indicators of societal responses. Sixth, it is not necessary for there to be a one-to-one correspondence between environmental issues and the indicators identified. A particular indicator can be relevant for more than one environmental issue.

Box 4.2 Discussion Point: National Versus Local Environmental Standards

The concept of 'national environmental standards' (NES) refers to limits set to maintain a certain level of environmental quality at the national scale. These standards are monitored via the use of environmental indicators. NES aim to provide a 'safe and clean' environment for the country as a whole, regardless of environmental pressures across space and irrespective of local costs and benefits. In contrast, 'local environmental standards' (LES) consider that development and environmental pressures are uneven geographically; thus, what constitutes 'safe and clean' should be a subject of local determination rather than a national standard. LES would require regional councils or local authorities to come up with their own LES. Those who debate the merits of LES versus NES confront the 'politics of space' and the 'politics of scale', as well as what constitutes the physical and human diversity of communities and their respective environmental circumstances. Clearly, the use, application and policing of standards set by environmental indictors is complicated by LES versus NES approaches to environmental management.

Critical thinking question: What the merits and drawbacks of national environmental standards versus local environmental standards?

Guided by the above principles, an ideal environmental indicator should meet all of the following ten criteria (OECD 1993).

1. Provide a representative picture of environmental conditions, pressures on the environment or society's responses.
2. Simple, easy to interpret and able to show trends over time.
3. Responsive to changes in the environment and related human activities.
4. Provide a basis for international comparisons.
5. Either national in scope or applicable to regional environmental issues of national significance.
6. Have a threshold or reference value against which to compare it so that users are able to assess the significance of the values associated with it.
7. Theoretically well founded in technical and scientific terms.
8. Based on international standards and international consensus about its validity.
9. Lend itself to being linked to economic models, forecasting and information systems.
10. The data required to support the indicator should be: (i) readily available or made available at a reasonable cost/benefit ratio; (ii) adequately documented and of known quality; (iii) updated at regular intervals in accordance with reliable procedures.

Box 4.3 Māori Environmental Indicators for Climate (Source: Ministry for the Environment 1998)

A Ministry for the Environment (1998) report considered the Māori dimension of climate change indicators. The two main conclusions were that Māori have a spiritual, philosophical and political perspective that needs to be taken account in environmental assessment. These include a holistic view of humans and the environment and the point that there are specific areas of environmental and economic concern for Māori (for example, shellfish abundance) for which there is indigenous knowledge of climatic sensitivities. Four Māori-relevant indicators were proposed: (i) alignment of Kowhai and mussel harvest; (ii) alignment between Pohutukawa blooms and kina harvest; (iii) spread of sand grasses and sedges; and (iv) depth of toheroa (a sand living mollusc). However, some of these are not solely a function of climate. For example, the depth of toheroa is influenced by many factors including human-generated toxic contamination. To assess the potential of these indicators, research would be needed to clarify and define the variables involved and to quantify the relationships of the variables to climate.

Critical thinking question: What are other possible Māori environmental indictors of climate?

The burden of achieving these demands can be simplified by directing effort to indicators that cover environmental priorities. Given limited funds and resources, governments typically establish environmental priorities where there is most concern with environmental conditions and scope to improve. As discussed in the previous chapter, New Zealand has established different priorities over the last few decades. The most recent were outlined by the Minister for the Environment (Ministry for the Environment 2011). Another consideration is to ensure that indicators are sensitive to the interests of different groups whose environmental priorities may vary or ways of recognising change may vary.

There are environmental indicators based on Māori knowledge and concepts to assess environmental change (Harmsworth 2002). They are tied in with Māori environmental management system of guardianship (*Kaitiakitanga*) developed to protect the *mauri* (life principle) of *taonga* (prized possession) and facilitate the sustainable use and management of natural resources (*taonga*). The indicators hinge on Māori environmental perspective, knowledge and *tikanga* (customs) (see Box 4.3). Examples include the national environmental indicators programme that aims at having Māori themselves participate in environmental monitoring and encouraging a Māori perspective for assessing the state of the environment (Harmsworth 2002). The indicators are based on Māori knowledge and Māori concepts specific to iwi and hapu communities, and development of these indicators takes place within a context of Māori environmental aspirations. In a project to assess wetlands, Māori indicators were based on Māori environmental concepts such as *kaitiakiatanga* (guardianship), *whakapapa*, (ancestral links), *mauri* (life force) and *taonga* (treasures, natural flora and fauna) (Harmsworth et al. 2002).

4.3 Composite Indicators

Environmental indicators capture individual components of the environment but are difficult to combine to show the overall state of the environment. For this purpose, a number of ways of reporting on aggregate environmental conditions have been proposed. These are frequently presented as measures of sustainability. Given the previous discussion of sustainability, here we focus on the strategies for developing composite indicators without judging which if any provides a measure of sustainability. Providing the measure is a basis for comparing some important aspect of overall performance it can remain helpful even if it remains uncertain whether it measures sustainability.

At the simplest level it is possible to assemble a group of individual indicators around a critical issue. A combination of indicators gives scope to assess changes in overall environmental quality allowing that deterioration in one way may be offset by improvements in other areas. For example, it has been suggested (Parliamentary Commissioner for the Environment 2002) that because of the highly urbanised nature of New Zealand society, focus should be on the key issues affecting the quality of the urban environment: energy consumption, area of urban land, number of dwellings, number of cars, solid waste disposal and population (Table 4.3). Clustering of indicators around a focal issue gives a basis for an overall judgement by considering the balance of positive and negative trends.

Another example of the use of a cluster of indicators to measure a focal issue is given by Statistics New Zealand's (2010) sustainability monitoring. From an original selection of 85 indicators, the measurement of progress in sustainable development has been reduced to 16 indicators grouped into four components: meeting needs (measured by the rate of unemployment, disposable income, health expectancy and physical safety); fairness (access to early childhood education, income inequality and economic hardship); efficiency of resource use (greenhouse gas intensity, energy intensity and labour productivity); preserving resources (distribution of selected native species, greenhouse gas emissions, nitrogen in rovers, adult education attainment, assets and infrastructure and speakers of te reo Māori).

On a larger scale than the monitoring of New Zealand's urban environment, the OECD (2011: 115) has proposed a framework for measuring progress with green growth. The concept of green growth was introduced in Chap. 1. Green growth is the OECD's way of reconciling support for continued economic growth with the maintenance of resources and environmental services. Green growth relies on two dimensions: raising the efficiency of resource use to lower the level of environmental impacts per unit of output ('greening growth') and harnessing new forms of economic development built upon environmental considerations. To monitor progress in green growth the OECD has proposed that individual indicators are selected to capture four components of green growth.

Table 4.3 Urban environmental progress indicators 1981–2001

Indicator	Change 1980–1996 (%)	Change 1981–2001 (%)
Gross domestic product	37	55
Total consumer energy use	44	61
Area of urban land	78	–
Number of dwellings	28	35
Solid waste disposal (Auckland only)	95	131
Population	16	19
Number of cars	31	67

Source: Parliamentary Commissioner for the Environment (2002)

- Environmental and resource productivity: to capture how efficiently an economy uses resources and environmental services recommended indicators include measures of the intensity of carbon emissions and energy consumption.
- Economic and environmental assets: recognising that increases in resource productivity does not ensure that environmental assets are maintained, indicators that measure the state of environmental resources and the ability to maintain environmental services are included. These indicators will include measures of resource stocks, biodiversity and ecosystem health.
- Environmental quality of life: the state of the environment can have direct impacts on the quality of life as where poor air quality is associated with a high incidence of respiratory illness. Indicators to capture environmental conditions that have immediate consequences for people include measures of air and water quality, incidences of waterborne and other diseases associated with poor environmental conditions and measures of pollution and toxic substances in the environment.
- Economic opportunities and policy responses: indicators on this dimension are to be chosen for their ability to capture the effectiveness of policy measures taken to promote green growth and to enable identification of where policy impacts are most marked. This is potentially the most challenging area to measure as it requires the separation of outcomes that are driven by purely cost and competitiveness considerations from those are a product of policy incentives and increased business prioritisation of green growth opportunities.

The OECD is continuing to develop guidance to help implementation of its green growth measurement framework. It notes how many measurement challenges need to be overcome. Trends in environmental and resource productivity are, for example, subject to displacement effects: a decrease in carbon emissions per unit of GDP in one country may simply be an outcome of a shifting to import goods with large carbon footprints rather than making them domestically (OECD 2011: 117). A contribution to green growth based on displacing environmental impacts to another economy provides a misleading impression of progress.

The Environmental Performance Index (EPI) prepared for the Davos World Economic Forum by the Yale Centre for Environment Law and Policy (see Chap. 1) is a similar attempt to combine individual indicators into an overall framework.

It differs partly through its emphasis on measuring the effectiveness of efforts to protect the natural environment rather than sharing the OECD's interest in promoting economic development. The most recent version of the EPI is built upon 25 indicators that are either direct measures of environmental quality or are proxy measures that offer a rough gauge of the effectiveness of environmental protection by measuring something that is thought to be closely connected to the issue of interest (Emerson et al. 2010: 11). So, for example, the extent to which agricultural practices are inconsistent with the natural environment is examined by measuring the extent to which governments provide subsidies to farmers.

The EPI is more than a set of individual indicators. For each indicator a policy target is identified consistent with a level of performance that is judged necessary to achieve a level of environmental protection needed to sustain ecosystems into the future. The policy targets are variously identified in international agreements, scientific consensus or, in last resort, the judgement of the researchers as to what is a desirable target. Indicators are then able to be converted into a progress score that captures how close the surveyed country is to meeting the policy target. By combining the progress scores it is then possible to derive an overall 'headline' indicator that reports the overall performance of the country with respect to the protection of its environment. The EPI does this in a three stage process where subsidiary scores are first derived for ten policy categories and then reduced to two performance areas: environmental health (based on indicators that measure impacts on or risks to human population) and ecosystem vitality (based on indicators measuring natural environment conditions and protection measures). The final score is based on the average of the scores for the two performance areas. Both the intermediary and final scores can then be compiled into a league table in which international comparisons can be made and changes in performance readily observed. As we saw in Chap. 1, this type of presentation can be highly effective in galvanizing public attention. The OECD similarly hopes to be able to refine its green growth framework into a set of standardised scores to facilitate headline measures of the extent to which economies are based on green growth as compared with conventional economic growth (OECD 2011: 114).

The EPI researchers do not claim that their policy targets equate to those required for 'full sustainability' (Emerson et al. 2010: 13). This is partly because they recognise that there is insufficient data to track many critical areas of environmental performance. The Index measures selected environmental issues that it is believed capture important components of environmental protection. By separating environmental health and ecosystem vitality the Index is able to capture situations where improvements in immediate living conditions are at the expense of environmental resources. The researchers are continuing to adapt and refine the construction of the Index so as to improve its coverage of representation of sustainability. While the EPI is still developing, changes in the construction of the Index have made it hard to track the performance of individual countries. For example, New Zealand's biodiversity performance has received markedly different scores according to whether species at risk or land area protected is used to best gauge threats to biodiversity (see YCELP 2002; Esty et al. 2006).

The EPI measures selected stresses on the environment and selected environmental management activities. The measurement is given greater purpose by being linked to policy targets over which there is degree of agreement. Nonetheless there is a danger that some critical areas are being missed or that displacement effects are not fully realised. This gives interest in ways of capturing environmental performance in a more complete fashion. In this regard it is worth examining ecological footprint analysis which has been presented as a way of tracking progress toward sustainability.

4.3.1 Ecological Footprint Analysis

An ecological footprint is a rough measure of how much land and water is needed by a population to sustain resource consumption and to dispose of or assimilate the waste produced (Rees 2000). It is an estimate of the 'burden' imposed by a given population on the environment and has become one way of comparing the environmental impact of individual countries that is especially favoured by those subscribing to 'strong sustainability' (Costanza and King 1999; Wackernagel and Rees 1996). The concept provides a way of linking human lifestyles to demands on the natural environment in a way that makes it possible to see the impact of consumption patterns and activities on ecosystems.

The concept of an ecological footprint has been developed as a tool for measuring progress toward sustainable development. It seeks to measure the total ecological cost of supplying all of the goods and services to a human population expressed in terms of the land area required. This recognises that land is embodied in all the goods and services that are consumed as well as directly in the space required by economic activities. So, for example, the land required for agricultural production includes farmland and space for processing factories plus the land needed to produce the inputs such as fertiliser, packaging, energy and transportation. In this way, ecological footprint analysis makes environmental demands more transparent than they otherwise might be. Some advocates of ecological footprint analysis go further by linking it to the idea of carrying capacity (Wackernagel and Rees 1996; Loh 2000). This assumes that land has a finite carrying capacity and that if this limit is exceeded resources are exhausted. This perspective, leads to the use of ecological footprints as a measure of how far individual countries are existing beyond their means. Of course, the extent to which human populations are faced by 'limits to growth' is debated but it is not necessary to resolve this controversy to make use of ecological footprint scores merely to make international comparisons of environmental demands.

Ecological footprint scores avoid the problems arising from the use of composite scores based on a selected range of indicators where some countries can be advantaged or disadvantaged according to the way indicators are selected and measured. For example, as noted above New Zealand performs well if the proportion of land area under conservation protection is measured but poorly if the proportion of native species under threat of extinction is measured. On the other hand, there is no accepted methodology for calculating ecological footprints and much difference in the judgement about the ideal calculation required (see Bicknell et al. 1998; van den Bergh and Verbruggen 1999; Wackernagel et al. 1999; van Vuuren and Smeets 2000; Lenzen and Murray 2001).

An issue with particular consequences for New Zealand is whether ecological footprint calculations should be based on a population's actual land requirements or those based on average requirements. For international comparisons, Wackernagel and Rees (1996) recommend the use of international averages rather than actual national land productivity or carbon dioxide sequestration rates. So for example when calculating New Zealand's ecological footprint to compare it with another country's both should be based on the same assumptions even if in one country trees grow faster or if it is possible to raise more dairy cows per hectare in one country than in another. The rational for the adjustment is that footprint score should measure the effort being made to be sustainable whereas countries with highly productive ecosystems may simply appear sustainable through the richness of their environmental resources. If little effort is made to stay within environmental limits the danger is that these productive ecosystems will be depleted and this danger should be reflected in the footprint measure. In New Zealand's case, the use of average land productivity estimates more than doubled the ecological footprint from 3.49 ha per capita to 8.35 ha (McDonald and Patterson 2003). The latest Global Footprint Network study places New Zealand around the middle of a range of high income economies (Global Footprint Network 2010). Opinions vary greatly as to whether this form of scoring is meaningful. It is included in the Living Planet Index produced by the Worldwide Fund for Nature and is favoured by such environmental campaigners.

4.4 Environmental Indicators and Reporting in New Zealand

There is no legislation in place in New Zealand that requires regular and independent state of the environment reporting at a national level. New Zealand is the only OECD country that does not mandate a regular environmental report. To date there have been two reports on the state of the environment, one in 1997 and another in 2007 (Ministry for Environment 1997, 2007). Both drew considerable criticism. For example, a commentary by the Parliamentary Commissioner for the Environment (2010) on the Ministry for Environment's 2007 State of the Environment Report identified a number of fundamental problems.

- The report was seen as attempting to accomplish too many functions, each of which require assessments or appraisals with different structures. The stated functions included setting environmental benchmarks and standards, supporting decision making, and highlighting changes to government policies and monitoring schemes and reporting on the condition of the environment.
- Some of the information presented was not useful as it did not indicate whether a particular problem was improving or getting worse and there was a general failure to draw conclusions on environmental problems.
- Some of the information was not trusted where, for example, commentaries on local and central government programmes for dealing with environmental

problems appeared in place of objective reporting of data. The report was not perceived to be independent of central government.
- There were significant gaps in environmental data.

The same report (Parliamentary Commissioner for the Environment 2010) critically reviewed the way in which New Zealand goes about measuring, assessing and reporting on the state of the environment nationally. The report highlights four key requirements that are essential for high quality and useful reporting. First, a need for appropriate environmental statistics that enable (i) the health of the various aspects of the environment to be diagnosed; (ii) the cause of environmental problems to be identified, and (iii) the success of environmental management and remedial measures to be assessed. Second, an independent agency should be given responsibility for reporting. Third, there should be clear accountability for reporting with the agency or organisation responsible mandated to report on the state of the environment. Fourth, the agency or organisation responsible should have the capability to conduct the required work, in particular, to process the environmental statistics so that information provided is suitable for quality state of the environment reporting.

Many of the problems in environmental reporting stem from inconsistencies in monitoring standards nationally as regards the type environmental variables that are monitored, the methods used, the frequency of monitoring, the timing of monitoring, and where and how the data are archived. To achieve useful and trusted state of the environment reports, there are three questions that should be addressed (Parliamentary Commissioner for the Environment 2010).

4.4.1 What Environmental Parameters Should Be Measured?

A problem here is in dealing with the dilemma of what can be measured versus what should be measured. The latter depends on the relative importance of the environmental problem. This can be decided by using answers to the following as ranking criteria. Is the environmental problem escalating such that it needs to be dealt with urgently? Is the problem approaching some critical tipping point that may trigger a destabilisation or dislocation of the ecosystem or environmental condition into some other state? Is the magnitude of the problem widespread or is it limited? Is there a natural mechanism that can be used to restore the system and thereby ameliorate the environmental problem? Is the problem reversible through technology management practices such that the natural environmental system is restored?

4.4.2 How Should Environmental Parameters Be Measured?

Once a decision has been made on the priorities in addressing environmental problems, relevant information needs to be gathered. The question arises as to how measurements should be done, specifically, where, how often, and by what methods? Decisions about where to measure must be done strategically. For example, are measurements intended to determine causality, such as sampling water quality above and below a point source of discharge? Or are measurements aimed at monitoring the overall health of the system? Answers to these questions would inform decisions on how frequently to take measurements; for example river water samples may be required weekly whereas soil quality measurements may only be required every 5 or 10 years. Decisions on what methods use are of fundamental importance given that environmental information comes from a number of sources. It is essential environmental statistics are standardised. To achieve this collection and analysis methods should be consistent and stipulate what, when and how samples are collected, how they are analysed, and how they are reported.

4.4.3 How Should the Information Be Made Available to the Public?

Environmental data should be readily accessible to all so that the reliability of reporting and conclusions drawn may be independently checked. This is best done via web-based datasets. Data should be available in non-aggregated form using standard formats, along with technical notes so that users can understand the information and assess its quality. Given that many different organisations play different roles in building databases of environmental statistics, special attention should be given collating and storing data from many providers and converting raw data into meaningful indicators.

4.5 Conclusion

Indicators of environmental health have multiple uses that, over the long term, serve to gauge the relative success or failure of various policies, instruments and laws for managing the environment. They permit regional and international comparisons by standardising and simplifying information about the environment. Policy makers and environmental managers can gain insight into the nature and severity of environmental problems and information provided by environmental indicators can guide additional data collection. They facilitate analysis of causes of environmental problems and the environmental consequences of policy and institutional changes.

Environmental indicators will be referred to frequently in the chapters that follow in relation to individual aspects of the environment. Several important points should be kept in mind when considering the information that they convey. Good indicators rely on high-quality monitoring and assembly of relevant data. Even when data is reliable, it should be recognised that indicators reduce uncertainty about the state of the environment but do not eliminate it entirely. They do not avoid a need to set targets so that there is something against which performance can be compared. Target setting may need to be sensitive to different locations, cultures and institutions. Assuming these issues are dealt with, indicators can play an important part in the way in which the environment is managed with the danger that 'what gets measured' is 'what gets managed'.

Study Guide

End of Chapter Summary

4.1 An environmental management principle can be judged according to whether it provides specific guidance on effective action. Sustainability, precaution and polluter pays are sometimes identified as principles but they do not provide clear guidance on environmental management options.

4.2 Environmental performance indicators are designed to satisfy a majority of the following criteria: policy relevant, measurable, analytically valid, environmentally informative, cost effective, and simple and easily understood. The PSR model is based upon three types of indicator: (i) pressure indicators describe the pressures on the physical environment caused directly or indirectly by human activities; (ii) state of the environment indicators relate to the quality of the environment; and (iii) societal response indicators show to what extent society is responding to environmental changes and concerns.

4.3 Composite indicators of environmental performance combine individual indicators into a single headline score for comparison between places and over time. The Environmental Performance Index (EPI) is an example of an attempt to design a composite score to rack how ell countries are protecting the natural environment. Ecological footprint analysis has been developed to measure of how much land and water is needed to sustain current levels consumption.

4.4 New Zealand does not have a good set of environmental statistics to enable monitoring of the state of the environment. There is no legislation in place in New Zealand that requires regular and independent state of the environment reporting at a national level.

Discussion Questions

Should New Zealand's approach to environmental management be based on principles of environmental m anagement?

What does the precautionary principle mean?

What are the strengths and weaknesses of the EPI?

What indicators can be used to help monitor New Zealand's transition to green growth?

What determines how useful environmental indicators are?

What exactly does an ecological footprint measure? How can it be reduced?

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Chapter 5
The Land

Key Questions

- What current environmental problems on land are those inherited from past changes?
- How can plantation forest be managed to bring environmental benefits?
- What are the major impacts of farming on the New Zealand environment?
- What are the main pressures on soil?
- What are the effects of soil erosion and where do they occur?
- What is biodiversity conservation and how is it managed in New Zealand?
- Why is the control of invasive species a priority in New Zealand?
- What arguments support giving Māori an important role in environmental management?

Abstract This chapter is concerned with environmental issues on land. The review commences with comment on past environmental changes since these provide the setting from which many of today's problems have evolved. Of all human activities, farming has had the greatest impact on the land with pastoral farming practices having particular impacts on soil erosion and land degradation. Nutrient contamination is a by product of heavy fertilisation of the soil for agriculture and may be considered a form of rural waste. New Zealand has a comparatively large area of land reserved for conservation purposes which has partly encouraged recent interest in opening up more of the conservation estate to mining. Classical problems of ecosystem loss and fragmentation have been countered in some regions by designating parks and reserves that cover roughly one third of the country. Unsustainable harvesting of native species has stopped, but problems still remain. The dual issues of invasive species and biodiversity loss are considered by some environmentalists to be symptomatic of the human presence in New Zealand that began with Māori settlement and continued with

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the coming of Europeans. Land holds a particular significance for Māori and there is ongoing debate over the sharing of environmental management responsibility.

Key Concepts and Terms Biodiversity • Biosecurity • Conservation land • Exotic forestry • Invasive species • Land degradation • Lowland forest • Māori land rights • National Parks • Pests • Schedule 4 • Soil degradation

5.1 The Setting

People first settled in New Zealand approximately 700–800 years ago and, as noted in earlier chapters, subsequent ecological changes have been dramatic. In the pre-1800 period following the arrival and expansion of Māori, forest cover was reduced and some 34 species became extinct including moa, the adzebill and the flightless goose. In the much shorter post-1800 period of European settlement the area of forest was further reduced to around 23% of the land, nine more birds became extinct and many more are threatened. Many new species were introduced (since 1840 over 80 species of mammal, bird and fish and more than 1,800 plant species) with massive consequences for the landscape and ecology.

Only about 30,000 of an estimated 80,000 multicellular species have been identified (Ministry for the Environment 1997). Most of the undescribed species are insects and fungi. Wildlife habitat sites and a number of ecologically representative areas have been surveyed over the past 30 years, but relatively few have been continually monitored; consequently, the status of most species and ecosystems is not known. A lack of data on pests and weeds is also a problem. Data on vertebrate pests, economic pests and a range of ecological and economic weeds exists but there is relatively little information about the population sizes and their spatial distribution. Little is also known about invertebrate pests in natural ecosystems (Ministry for the Environment 1997).

Not all of New Zealand's current environmental problems on land are those inherited from past changes (Box 5.1). The effects of more recent and on-going activities are of growing concern. Often they appear individually small but are cumulatively significant. In a modern context, farming dominates New Zealand's landscape and has the biggest environmental impact. There are approximately 70,000 farms in New Zealand with over half the country's land area is classified as farmland (Parliamentary Commissioner for the Environment 2005). In contrast, just over 30% of New Zealand's total land area of 26 million hectares is formally protected conservation land. Of the total area, marine and terrestrial, 32% is protected, more than twice the average for OECD countries (Table 5.1). Nearly 50% of this is in highland environments of the Southern Alps and the central plateau area of the North Island.

Box 5.1 Discussion Point: Precious Caves at Risk in Legislative Vacuum (Source: de Freitas 2005, 2010)

There was widespread controversy in New Zealand during November 2005 over the Department of Conservation allowing world adventure racers into Te Tahi cave on the West Coast of the South Island. The controversy highlighted an important environmental issue of national significance that is being stubbornly ignored. Present legislation on caves echoes the view that they are just cavities in the ground owned and controlled by those who own the land above. In a more enlightened, contemporary view, caves are seen as valuable environmental assets, considered to be non-renewable resources, as damage to cave features may take several human lifetimes to recover, or never recover at all. Te Tahi cave contains stunning stalagmites and stalactites thousands of years old. Other caves contain amazing rivers and caverns. The famous Waitomo caves have many attractions and play a vital part in the nation's tourist industry.

There are direct and indirect impacts to consider when managing access. Direct impacts include breakage of delicate stalactites and stalagmites, construction of access routes through caves, alteration of the cave microclimate from entrance modifications and visitor numbers, the build-up of carbon dioxide in the cave from human breath that combines with moisture to corrode limestone features, accumulated lint from clothing (on which bacteria feed), and heat from people and lights. Many of these impacts are cumulative and often lead to irreversible degradation to the cave ecosystem. Indirect impacts are mainly those caused by so-called surface effects resulting from agriculture, the construction of car parking areas, walking tracks, kiosks, toilets, hotels and motels and may add to the direct underground impacts by affecting sediment and impurities in runoff into streams, cave passages and caverns.

Tourism Holdings Ltd (THL) operates the famous Glowworm, Ruakuri and Aranui caves in Waitomo and several other tourist activities in the limestone countryside. To help preserve the features of the Waitomo caves and manage the regional resource sustainably, THL funds a 'Cave Management Advisory Committee', set up in 1996, which later changed its name to the Waitomo Caves Environmental Advisory Group (EAG). The EAG includes scientists and representatives from the Department of Conservation and THL. The EAG's success hinges on the balance it allows between conservation of natural and cultural resources with tourism operations.

Critical thinking questions: What sort of legislation might be set out to protect caves? What would this legislation specify?

Table 5.1 A comparison of protected areas expressed as a percentage of total area (marine and terrestrial) for OECD countries

Country	Area protected (%)
New Zealand	32
Canada	9
Korea	10
Australia	19
Netherlands	19
Sweden	10
Switzerland	29
OECD Europe	14
OECD	16

Source: OECD (2007)

5.1.1 Indigenous Forests

At the time of first human settlement in New Zealand, indigenous forests covered about 85% of the land area. Now these forests cover only 23% of the country and are mostly confined to mountain areas and to some low-lying parts of the West Coast, Southland and Northland. About 20% of the surviving indigenous forests are owned by the New Zealand government and the rest, about 1.3 million hectares, are privately owned (OECD 2007). Most of the government-owned forests are on fully protected conservation land. A 120,000 ha area of native, state-owned forest on the West Coast of the South Island had remained open to logging up to 1999 under the West Coast Forest Accord as a negotiated compromise between conservationists and logging interests. That Accord ran from 1986 until 1999 when a new Labour government ended logging of all indigenous West Coast forests on state land, setting up a NZ$120 million regional development fund by way of compensation (Young 2004: 214). Most of the private indigenous forests are not protected by legislation, but timber production from them is subject to the sustainable management provisions of the Forests Amendment Act 1993 (see Chap. 3). The biggest threat to the remaining forests comes from tree and seedling destruction by animal species introduced by humans, mainly possums, goats and deer. These pose a serious risk to biodiversity, in particular the almost two million hectares of government-owned land. The Department of Conservation runs pest control operations over most of this. Invasive exotic plants are also a threat and are also subject to the Department's control operations.

The lowland forests of the North Island have been largely removed and what remains are isolated fragments. Because of this fragmentation, lowland forest ecosystems are highly susceptible to degradation, mainly reduction in species diversity. The other main pressures on biodiversity are the declining quality of many of the remaining land and freshwater habitats and the impacts of pests and weeds. The main responses to biodiversity decline have focused on ecosystem and species recovery programmes on offshore islands and extensive pest control operations on the mainland, but the need for partial restoration of representative indigenous lowland and coastal ecosystems and for wider protection of marine ecosystems has yet to be addressed. There is evidence that several strains and varieties of beneficial exotic species may be disappearing and this may have significant long-term economic impacts on New Zealand's agriculture, horticulture and forestry. Pest control, especially of possums, is seen as a crucial means of protecting the New Zealand's native plants. However, it is accepted that pest control will need to become increasingly safe, humane and cost-effective to remain economically and socially sustainable.

5.1.2 Exotic Forests

A major change in the state of New Zealand forests began in the early twentieth century. As the country's economy developed and human population expanded, the demand for wood increased. When it became clear that the supply of native timbers was becoming scarce, large scale planting of exotic forests commenced. It was not long before forestry based on plantations of exotic conifers, mainly *Pinus radiata*, became the next major land use after pastoral farming. The first planting boom started in the 1920s, mostly on poor pumice land in the central North Island (Purey-Cust and Hammond 1995). A second planting boom, which began in the 1960s, was on land scattered throughout the country, often replacing cutover native forest and secondary growth. A plan to convert extensive areas of beech forest to pine plantations led to a protracted dispute in the 1970s between foresters and environmentalists. In the end, the proposal was shelved indefinitely.

The third planting boom in the 1990s was spurred on by high export earnings from pine logs and low returns from lamb meat and wool. Most of this new planting was on pasture land, about a third of it on steep hilly land that was cleared of native forest earlier. The straight replacement of native forests with exotic plantations ceased in by the end of the 1980s, due mainly to public sentiment and the realisation that native forest ecosystems had been decimated and in certain areas unlikely to recover. However, in some regions, native scrubland was still being cleared and planted with exotic trees on small plots of private land (McLaren 1995). In 2004, planted forests covered approximately 1.6 million hectares and up until then were expanding over former farmland at a rate of about 70,000 ha per year. In 2005, the land area taken up by exotic forests declined by 1,000 ha, the first time in two decades that more land was taken out of forestry than planted in trees. A net loss of exotic forest plantations continued over the rest of the decade partly as returns to other land use activities improved and partly from concern that controls might be placed on the loss of forests once an emissions trading scheme was introduced.

Indigenous forest accounts for around 23% of the 83,000 km^2 of forest with the remainder being plantation forest (OECD 2007). About 77% of indigenous forest is on government-owned land while 94% of plantation forest is privately owned.

5.1.2.1 Exotic Forest Threats

Over time and with the increasing influence of the conservation movement, exotic forests came to be seen as a threat to biodiversity. The evidence for this is disputed. As the forest matures, especially those on fertile sites where there is adequate rainfall, moderate to high levels of indigenous plant, insect and bird diversity develop (Clout and Gaze 1984; Ogle 1976, 1989; Allen et al. 1995; Ledgard 1995; Spellerberg and Sawyer 1995). On the other hand, Rosoman (1995) points out that it is false to claim they are biodiversity havens (Rosoman 1995; Spellerberg 1996). This possibility needs to be kept in proportion as it is wrong to imply that biodiversity flourishes. Plantation forests have two major limitations as habitat for native animals (Steven 1995). First, most species have evolved behaviour which is especially adapted to the native forests. Pine plantations have fewer suitable eating, nesting and breeding sites. Second, the short harvest cycles of plantation forestry mean that any native understorey which does develop provides only temporary habitat.

Different logging methods have different effects on ecosystem structure. Clear-felling is the local removal of all trees, often followed by burning of debris. The method is favoured by logging companies as it is the cheapest and simplest method of wood harvesting. The environmental drawbacks are that the soil tends to be exposed to erosion, and regrowth is often less diverse, both in terms of variety species and the age of trees. Modified clear-felling or shelterwood logging keeps some trees for conservation purposes such as preserving animal habitat and to allow further growth of immature trees and seedlings. The resulting forest retains a greater diversity of species and age classes. Shelter trees may be harvested once some regrowth is established. Selective logging removes individual trees or clusters of trees focusing on a particular species, sizes or ages, the general aim being to retain diversity of species, sizes and ages. This is referred to as sustainable harvesting of timber, a practice that spread after the Forest Amendment Act 1993 prohibited the milling and export of indigenous timber that has not been harvested sustainably (Box 5.2).

Box 5.2 Discussion Point: Chips Can Save Trees (Source: Memon and Hawes 2000)

The Forest Amendment Act 1993 prohibits the milling and export of indigenous timber that has not been harvested sustainably, meaning in a way that 'maintains the ability of the forest growing on that land to continue to provide a full range of products and amenities in perpetuity while retaining the forest's natural values'. Previously, the control of indigenous forest logging had been through negotiated accords that were of uncertain status as well as through some limited capacity to acquire forests for conservation. The Act was of significance mainly to lowland indigenous forest most of which remains outside the conservation estate and in private or Māori ownership. In the South Island, silver beech (*Nothofagus menziesii*) is the main indigenous species of tree found on privately

(continued)

Box 5.2 (continued)

owned land. From 1955 to 1980, the amount of indigenous timber harvested had more than halved from a peak in 1960 but an increasing proportion of the harvest went into wood chips exported to Japan. The Forest Amendment Act ended this market by prohibiting all export of native timber except sawn beech and rimu (*Dacrydium cupressinum*) taken from certified forests and produced within specifications that made use for chipping unlikely.

The intent of the legislation was to give an incentive to sustainably manage forests by still allowing the export of two forms of timber, as well as allowing sustainably harvested indigenous timber to be incorporated in finished products for export. In the context of Southland's privately owned beech forest, forest owners argued that a more liberal export regime was compatible with sustainable forest management. Beech is suited to being harvested on a sustained yield basis because of its rapid regeneration, but the ability to harvest only trees of sufficient quality to produce sawn timber is a constraint. In a previously unmanaged forest, only a low proportion of trees available for harvest in the first sustainable cuts are likely to meet the required grade. Others are likely to be of irregular shape or affected by fungal rotting. To provide a financial incentive, forest owners believed that an export market for low grade timber had to be maintained. Further, it was claimed that an initial harvest including trees not suited for high grade timber would result in an improvement in the quality of wood harvested in subsequent rotations. On the other hand, from the perspective of protecting indigenous forest (as compared with the industry based on indigenous timber) the regime introduced by the Forest Amendment Act 1993 was highly effective in reducing timber extraction, especially after some initially exempted state owned forest on the South Island West Coast was brought under the scope of the legislation.

Critical thinking question: What criteria would you recommend to judge the sustainability of indigenous timber harvesting?

5.1.3 Grasslands

Except in tussock grasslands, native grasses formed only a minor part of original vegetation when European settlement began. Tussock grassland covered most of the land east of the main divide in the South Island and in the North Island small areas on the Volcanic Plateau and in Hawke's Bay. The grasses were tuft-like and grew in clumps to produce the 'tussock grasslands'. These areas provided a certain amount of food for introduced livestock, especially the new growth, which came away from the top of the tussock after burning. The practice of periodic burning together with the grazing of sheep and invasion of rabbits resulted in the destruction of much low-tussock country. The lowland tussock was easily ploughed and sown with introduced grasses; as a result the plains of the South Island were developed for farming

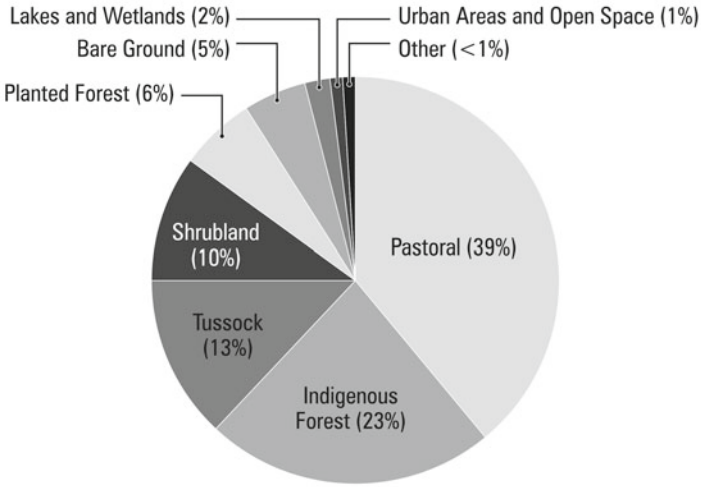

Fig. 5.1 New Zealand landcover 1997. Source: Parliamentary Commissioner for the Environment (2002)

more rapidly than the forest-clad North Island (Goulding 2006). Today, there are about 3.3 million hectares of remnant tussock grassland and nearly one million hectares of mixed scrub and tussock (Fig. 5.1). Almost this entire remnant tussock has been grazed by livestock, at least 1.5 million hectares have been degraded by sheep, rabbits and invasive weeds, and about half a million hectares have been transformed into pastures with introduced grasses.

5.1.4 Farming

Farming has had a major impact on the New Zealand environment. Before humans arrived in New Zealand grasslands covered approximately 5% of the land area but expanded to over 50% of the total land area as a result of deforestation by farmers and timber millers. In the 1990s just over 50% of land area was used for agriculture compared to the world average of 37% at that time (Ministry for the Environment 1997). It is notable that the total land area farmed decreased by 26,000 km^2 between 1984 and 2004 (from 145,000 to 119,000 km^2) and the land use switched to forestry or residential development or left to revert to scrubland and native bush (OECD 2007). The proportion of land used for agriculture shrank to 44%, with 97.5% given over to grazing, 1.4% to crops and 1.1% to horticulture and viticulture (OECD 2007). Farmland is heavily stocked with sheep and cattle. In contrast to the country's human population, which was 4.2 million in 2009, there were about 32 million sheep, 6 million dairy cattle, 4 million beef cattle and just over 1 million deer spread over approximately 9 million hectares of sown pasture (Statistics New Zealand).

5.2 Land Degradation

Soil degradation is one of the world's most pressing environmental problems (O'Riordan 1995; Varis 2006). All the main processes of soil degradation can be found in New Zealand, namely:

- *Water erosion*, which includes sheet, gully and splash erosion as well as mass movement such as landslips.
- *Chemical degradation*, which covers a range of processes including the leaching of nutrients, the accumulation of toxic elements and acidity.
- *Physical degradation*, which involves adverse changes to such physical properties of the soil such as porosity, permeability, soil structure, compaction and sealing and crusting of soil surface, often leading to a reduced infiltration capacity.
- *Salinisation*, which is a process that increases the salt content of the soil.
- *Wind erosion*, which is the removal of soil by wind.
- *Biological degradation*, soil degradation consisting of the mineralization of humus and an increase in the activity of micro-organisms responsible for organic decay, resulting in an overall decrease in organic matter.

Soils can be reinstated with large technical inputs and declines in productivity can be compensated for by applications of chemical and fertilisers.

New Zealand's soils tend to be thin and acidic with low levels of nutrients, especially nitrogen, phosphorus and sulphur. As a result, nearly all soils used for crops and pasture need to be upgraded and maintained with nitrogen-fixing legumes (for example, clover), significant amounts of fertilisers, especially lime (calcium oxide) and urea (nitrogen). If nutrients are applied to the soil at a rate beyond which plants are able to assimilate them, they will seep out in to the wider environment causing damage to the environment. The environmental impact of these is mainly on ground water quality, lakes and streams or entering the atmosphere, which is dealt with in the following sections. Surprisingly, other than soil erosion, there are no national data on soil degradation, such as carbon depletion, nutrient depletion, acidification, compaction and contamination though these are thought to be widespread.

The main pressures on soil are from past deforestation on land susceptible to erosion, localised accumulations of harmful chemicals or waste products and the impacts of over-cultivation or overstocking on erosion-prone and compaction prone land. All but a quarter of New Zealand's land sits on geologically young sedimentary rocks and two-thirds of the country consists of hills and mountains. Areas of highly fertile soil and flat to gently rolling terrain are limited. As a result only about 31% of the land can sustain pastoral farming without significant erosion controls.

5.2.1 Soil Erosion

Soil erosion is a natural process that has been accelerated in New Zealand by deforestation and imprudent land use practice such as deforestation and overgrazing. Accelerated erosion is the most serious of the soil degradation problems. The main forms of soil erosion in New Zealand are mass movement erosion, fluvial erosion, surface erosion, and streambank erosion.

Over 50% of the country is affected by moderate to slight erosion and about 10% has severe to extreme erosion, mostly concentrated in the eastern North Island, from Wairarapa to Gisborne, parts of Taranaki and the South Island high country. It has been estimated that New Zealand loses up to 300 million tonnes of soil to the oceans every year, which is about 10 times faster than anywhere in the rest of the world (Parliamentary Commissioner for the Environment 2005). This estimate suggests that New Zealand accounts for about 1.7% of the world's soil loss to the oceans, despite having only 0.1% of the world's total land area (Parliamentary Commissioner for the Environment 2005).

Soil erosion is one of the most important long-term environmental impacts related to agriculture and forestry. It is noteworthy, however, that although agricultural activities are responsible for about 34% of national soil loss (about 227 million tonnes per year), a large share occurs elsewhere, in particular native tussock and hill country areas and in some indigenous forest areas (OECD 2007). The two main areas are the west coast of the South Island extremely erosion-prone land on the east coast of the North Island.

The hill country in New Zealand is highly susceptible to soil erosion due to the underlying geology, topography and climatic conditions. Hill country is defined as land with greater than 15° slopes and located below an altitude of 1,000 m above sea level (Ministry for the Environment 2008). Using this definition, 37% (ten million hectares) of New Zealand's total land area is classified as hill country, with most of it (6.3 million hectares) located in the North Island (Basher et al. 2008). In the North Island, approximately 200,000 ha of hill country has a mapped potential erosion severity of severe to extreme, with most erosion prone areas located in the East Coast region. The geology of the hill country landforms here is mostly soft rock. Mass movement (soil slip and earthflow erosion) is the most common form of erosion, but sheet and gully erosion is also common.

Soil erosion on farmland is caused by removing plant cover by burning pasture or felling trees, shelter belts or forests, by having too many animals on the land and by bad cultivation practices. Soil erosion is a problem for several reasons. On farms, it damages land improvements, it reduces the soil's productive capacity. Erosion of farmland also causes disruptions elsewhere, such as by contributing sediment to waterways reducing the quality of water available to downstream users. Changes in land management can reduce these effects. Land can be cultivated in ways that minimise damage to soil structure. Pasture can be grazed in ways that reduce depletion of ground cover and unstable hill country can be protected against slips and gullies by reinforcing the soil with tree roots at weak points. Siltation of waterways can be reduced by managing stock access to stream banks. Other erosion control techniques include: maintaining adequate vegetative cover by avoiding over-grazing and maintaining a healthy grass cover; spaced or close tree planting; retiring land from pasture; fencing off and planting river banks; and building debris dams to slow water flows in gullies.

Table 5.2 Types of agricultural impacts on water quality as rated by officials in a survey by the Ministry and Agriculture and Fisheries, ranked on a scale from 0 = no damage to 10 = severe damage

Type of impact on water quality	Average rank
Sedimentation	6.4
Nutrient contamination	6.2
Alteration of physical characteristics	5.6
Faecal contamination-surface water	5.4
Nitrate contamination-ground water	4.6
Pesticide contamination-surface water	2.8
Faecal contamination-ground water	2.8
Pesticide contamination-ground water	1.6

Source: Sinner (1992) and Ministry for the Environment (1997)

The average annual suspended sediment yield from agriculture is estimated to be 6 tonnes/ha. Over 99% of the agricultural land on which erosion levels were more than this was pasture rather than arable or horticultural land (OECD 2007). Since 1980, about 1.2% of agricultural land (1,640 km^2) has been subject to severe erosion, losing over 33 tonnes per hectare per year (Landcare Research 2004). A further 1% has experienced high erosion (22–32.9 tonnes/ha), 3% moderate erosion (11–21.9 tonnes/ha) and 5% slightly elevated erosion (6–10.9 tonnes/ha). On the remaining 89.5%, the estimated annual erosion rate is considered to be "acceptable" at less than 6 tonnes/ha (OECD 2007). Sedimentation of waterways from agricultural activity is the leading cause of reduced water quality in New Zealand (Table 5.2).

Rather surprisingly, some data suggest that the harmful effects of soil compaction and pugging surpass those of erosion (Sparling 2004). Data from 600 sites throughout New Zealand showed that compaction is greatest on cropping and horticultural land due to tractor use and on dairy pasture due to stock density. Soil compaction and pugging are worst in areas where there are prolonged wet soil conditions, combined with high stocking density on paddocks, especially on clay soils. The effect of soil compaction and pugging is poor grass growth and thus a reduction in pasture yield, also greater run-off of soil and contaminants to waterways.

The effects of soil erosion from farmland are twofold: a valuable resource is lost from the farm and the downstream effect of eroded sediment entering waterways is enormous. Sedimentation contamination in waterways does a great deal of damage. The environmental effects include (Parliamentary Commissioner for the Environment 2005; Davies-Colley et al. 2003):

- degradation of substrates for bottom-dwelling organisms
- reduced food quality for bottom-dwelling organisms (in streams)
- clogging of fish spawning gravels
- smothering of estuarine animals
- shoaling of estuaries

- infilling of lakes and reservoirs
- siltation of water supply intakes

Recovery from the impacts can take many years, with some being more or less irreversible as in the case of estuary shoaling or lake infilling (Davies-Colley et al. 2003)

Soil conservation is increasingly been seen as the responsibility of the land user rather than that of government. Forest planting, regeneration of native vegetation on some erosion-prone land and the formation of land care groups are the main response trends. Lack of good quality data on the country's soil problems and rates of erosion is an underlying problem that is not being addressed. Other indicators of soil quality, such as nutrient and carbon loss, compaction, acidification and site contamination, have not been surveyed at the national level, though patchy data exist at regional and local levels.

5.2.2 Soil Contamination

In addition to soil erosion, soil contamination is also a problem, although the data are sketchy. Several thousand of the nation's 80,000 farms and orchards and market gardens are thought to have contaminated sites such as disused sheep dips, farm landfills, heavy metal residues from fungicides, though no instance of extensive and serious contamination is known. There were an estimated 7,800 chemically contaminated urban and industrial sites in the 1990s, 1,500 of these were seriously polluted. Examples of contaminated sites include service stations, railway yards, sawmills, chemical manufacturers, timber treatment plants, engine works, metal industries and landfills.

The 1996 Hazardous Substances and New Organisms Act requires the safe use and disposal of hazardous substances (see Chap. 3). New Zealand signed the Stockholm Convention in December 2004, a United Nations treaty that bans the making, use or importation of 12 particularly unsafe and long lasting chemicals. This includes pesticides, such as DDT and dieldrin, which is used in sheep dips and timber treatment plants, polychlorinated biphenyls (PCBs), the pesticides aldrin, chlordane, endrin, heptachlor, mirex, hexachlorobenzene and toxaphene and dioxins and furans (polychlorinated dibenzo-p-dioxins or PCDDs, and polychlorinated dibenzofurans or PCDFs). In 2005, New Zealand government banned fires at landfills, the main source dioxins in the atmosphere (Ministry for the Environment 2006). Chapter 10 provides some further discussion of landfill and waste management.

5.3 The Conservation Estate

New Zealand has a comparatively long history of protecting areas of landscape and conservation importance. Tongariro was designated a National Park in 1894, the fourth to be designated anywhere in the world. European settlement resulting in a large amount of land being in Crown ownership was an advantage in not requiring land acquisition specifically for protection purposes. The first National Park partly came about through the shrewdness of Te Heuheu Tukino who gifted the land around the three central North Island volcanoes to the state. Te Heuheu the paramount chief of Ngati Tuwharetoa, whose tribal land formed the basis of Tongariro National Park judged that gifting the area as a national park offered the best prospects of keeping the land in tact (Thom 1987). Interest in nature conservation and the protection of natural curiosities was growing at the time. In 1891, the Australasian Association for the Advancement of Science had called for the establishment of public reserves for the preservation of native flora and fauna, specifically drawing attention to the offshore islands – Resolution Island and Little Barrier Island (Young 2004). Resolution Island was established as a flora and fauna sanctuary in 1891 and Little Barrier Island (1894) and Kapiti Island (1897) and several smaller islands followed shortly after (Hill and Hill 1987; McLean 1999). The strategy of transferring threatened birds to offshore islands dates from this time.

By 1930 there were six national parks: Tongariro, Egmont and designations that today form parts of Arthur's Pass, Fiordland and Mt Cook National Parks. The first parks tended to be situated in mountainous areas and valued as unspoilt areas of scenic wilderness. The area of land designated in 1907 amounted to 52% of the area in all national parks in 1980, an early contribution helped by the first designations covering land of minimal value for agriculture. Today 14 national parks cover 3,084,939 ha – about 11.5% of the country's total land area. Management of the national parks was first integrated under a single piece of legislation in 1952 that enshrined the dual role of parks to preserve indigenous flora and fauna and to allow free public entry for recreational purposes (Thomson 1976). The National Parks Act 1980 forms the basis of management today. It states that national parks contain 'scenery of such distinctive quality, ecological systems, or natural features so beautiful, unique, or scientifically important that their preservation is in the national interest'.

Outside of the national parks the larger conservation estate comprises conservation parks (1.9 million hectares), ecological areas (176,000 ha), stewardship areas (two million hectares) and various types of reserve and other specific designations (see Parliamentary Commissioner for the Environment 2010: 13 for definitions). The largest areas among these designations are motivated by recreational and historic as well as conservation interests. Ecological areas differ in being created as representative examples of the full range of ecosystems that occur within identified ecological regions (Parliamentary Commissioner for the Environment 2010). Their origins were partly to provide the former New Zealand Forest Service with reference areas that could be compared with comparable areas of forest that were being logged. Some of the original designations have since been incorporated within other designations including national parks. The Parliamentary Commissioner for the Environment (2010) has suggested that remaining areas potentially merit greater recognition than their existing designation gives.

Since the 1980s, additions to the conservation estate have emphasised coverage of different environments. This is reflected in National Parks being created on

Stewart Island, the South Island west coast and around parts of the Whanganui River. Conservation of indigenous forests has been assisted through the permanent conservation of 1,300 km^2 of state-owned indigenous forests on the West Coast (OECD 2007). Further scope for expansion of the conservation estate has been seen to exist in the South Island.

The suitability of the South Island high country for extensive pastoral farming has been subject to differing assessments. Evidence of habitat destruction and soil erosion is set against 'European myths of exploration and pastoralism' in a 'landscape of sheer grandeur' also prized for mountain recreation (Young 2004: 225). At the time of the Department of Conservation's creation, this land amounted to 10% of New Zealand's total land area. It fell outside of that automatically transferred to the Department's management as much of it was leased to high country farmers. In 1998, the Crown Pastoral Land Act introduced an innovative scheme in which pastoralists could elect for a tenure review that would give a right to purchase some of their land in return for ceding other parts of their lease holding to the Department of Conservation. This has provided a mechanism for gradually shifting farming activity to areas of the high country of least ecological importance. At the same time, the reform built on the idea that sustainable resource use would be encouraged by freehold title. Through the scheme, it was hoped to add over half the affected high country to the Department of Conservation's control. In 2003, the objectives for the scheme were extended to include progressive establishment of a continuous network of high country parks and reserves. The Parliamentary Commissioner for the Environment (2009) in reviewing progress toward environmental stewardship recommended that a wider range of land ownership and management models should be contemplated than simply the alternatives of public or private ownership. It noted, for example, that land that is marginal for farming is not necessarily of ecological or recreational importance.

5.3.1 Mining the Conservation Estate

Land in the National Parks is not available for mining but only a small part of the rest of the conservation estate is off limits, as listed on Schedule 4 of the Crown Minerals Act. This leaves around 60% of conservation land potentially open for mining subject to the permit, access and resource consent requirements. In March 2010 the New Zealand Government issued a discussion paper proposing that some conservation land be removed from Schedule 4 to allow it to be considered for mining. Predictably there was a public outcry. A protest march of an estimated 40,000 people in downtown Auckland reflected the strength of public feeling (Parliamentary Commissioner for the Environment 2010). In response, the Government decided in July 2010 not to remove any land from Schedule 4, but to consider expanding mining on public land, which included the 60% on conservation land. To facilitate this desire to encourage more exploitation of New Zealand's mineral wealth, the Minister of Energy and Resources was made jointly responsible with the Minister of Conservation for the granting of access to conservation land. At the same time, decisions about access are no longer to be made around whether conservation concerns are protected: consideration of the economic, mineral and national significance of the proposed mining activity is also to be given. In the view of many, this change was profound as it allows the Minister of Energy and Resources a role in decision making on both to granting permits for mining and access to the conservation estate, thus also diluting the role of the Minister of Conservation as guardian of the conservation estate.

Mining is New Zealand has a relatively long history, beginning with Māori use of pounamu (New Zealand greenstone) for tools and ornaments and later gold, coal oil and gas. Much of the mining activity is on public land, including 57 mines currently operating on conservation land (Parliamentary Commissioner for the Environment 2010). Driving the attempt to open up more of New Zealand to mining was awareness that world demand for minerals has been growing and that while Australia continues to prosper economically by allowing its mineral wealth to be mined New Zealand risks slipping further behind its neighbouring economy. The Government wanted to boost New Zealand's wealth by expanding mining on public conservation land. Public pressure led to a back down in respect of reducing the area of land protected by Schedule 4 of the Crown Minerals Act. As part of the back down, the Government announced it would undertake aero-magnetic surveys of mineral potential in Northland and the West Coast and implied that more mining on land not on Schedule 4 will be encouraged.

The environmental effects of mining on conservation land are controlled by the Department of Conservation and by local authorities. The former determines conditions of access to mining sites and the latter sets of conditions in resource consents issued under the Resource Management Act. This arrangement, however, does not mean that control is effective, even if it is administered wisely. A reason for this is that, historically, conservation initiatives have concentrated conserving non-productive high country and rugged areas so that many ecosystems fell outside the conservation estate.

The extent to which mineral extraction is environmentally damaging depends on whether the extraction method is open cast mining, dredging or underground mining. Impacts can be direct (for example removal of rock, soil and vegetation) or indirect such as impact on water quality. Control on minimising impacts is administered jointly by the Minister of Conservation and local authorities. Mining companies must obtain resource consents from the relevant local authorities under the Resource Management Act 1991. During its campaign to get public support for the opening of more conservation land for mining, the government referred to the precedent of the Pike River coal mine as an example of how mining could be conducted in a conservation area with minimal environmental impact. The Pike River coal mine is beneath conservation land in the Paparoa Ranges of the South Island West Coast. The mine was praised by government ministers as a showcase development that had set new environmental standards for coal mining and that offered a model to be replicated on other conservation land (Pike River Coal Limited 2009: 8). In November 2010, within a year of becoming a production mine, a gas explosion in the mine killed 29 men and led to the mine's closure. An issue before the subsequent

Royal Commission of Inquiry into the causes of the disaster is whether mine safety was compromised by efforts to minimise the environmental impacts of the mine.

Prior to the Pike River disaster, the ‘mining of conservation land’ debate had largely been conducted around the extent to which mining is compatible the dual goals of (a) maintaining the country’s “clean and green” image, not only as a marketing brand, but also (b) protecting biodiversity, unique ecosystems and landscapes because of their intrinsic value to mankind. There are those who believe that payments for mineral extraction rights could be used, not only to compensate for damages that mining causes, but also to provide a net conservation benefit such as in waging the battle against introduced pests. The Parliamentary Commissioner for the Environment (2010) called for conservation interests to remain uppermost when considering applications for mining but noted that the impacts of mining tend to be localised. Introduced pests were identified as a more pervasive threat to the conservation estate.

5.4 Biodiversity

Biological diversity or *biodiversity* refers to the variety of all living organisms, often defined as the sum of genes, species, and ecosystems of a region. To some people biodiversity conservation is overly concerned with visible aspects of species and ecosystems. They argue that the vast majority of Earth’s biodiversity is microbial. But methods for assessing biodiversity involve more than counting the number of species. Neither is it only about functional redundancy, which is a characteristic of species within an ecosystem where certain species contribute in equivalent ways to an ecosystem function such that one species may substitute for another. The loss of a species upon which others depends is a far more serious matter. Environmental managers and ecologist focus on the relative importance of each species and on their ability to survive against human caused environmental pressures. The global community affirmed its concern for threats to biodiversity in the early 1990s. The Convention on Biological Diversity was signed at the United Nations 1992 Earth Summit and ratified in 1994. New Zealand’s strategy for dealing with threats to biodiversity came soon after.

The New Zealand Biodiversity Strategy was prepared in response to the state of decline of New Zealand’s indigenous biodiversity, described in the State of New Zealand’s Environment report (Ministry for the Environment1997) as the nation’s “most pervasive environmental issue”. It also set out to implement the Convention on Biological Diversity within New Zealand. The Department of Conservation coordinates implementation of the Strategy, but seven other government agencies are involved in implementing parts of the New Zealand Biodiversity Strategy. The purpose of the New Zealand Biodiversity Strategy is to establish a considered framework for action, to conserve and sustainably use and manage the country’s biological diversity. The primary focus is on indigenous biodiversity; however, because of the economic importance of some of the introduced species, conservation of these is also addressed. Native biodiversity on private land (which is 70% of the country) receives no formal recognition under the Strategy.

New Zealand has a special role to play in a global context because, as noted in Chap. 1, a large percentage of its 90,000 native species are unique (OECD 2007). Perhaps because of this, most biodiversity conservation in New Zealand to date has focused on individual species and this is reflected in the fact that since the 1990s, the security of 200 endangered species has improved and there have been no known species extinctions (OECD 2007). However, there is growing awareness of the importance of functional diversity and not just species richness in maintaining the integrity of ecosystems (Craig et al. 2000). Craig et al. (2000) use the examples of pollination and seed dispersal to highlight this issue. Some protected forests in New Zealand are deficient in many of their original pollinators and seed dispersers, thus their future is uncertain. A poor understanding of these interdependencies hinders good environmental management.

5.4.1 Control of Invasive Species

The impact of invasive species on indigenous ecosystems has been identified as the second most important global influence on biodiversity loss globally after land use change (Parliamentary Commissioner for the Environment 2000). In New Zealand's case, it has been judged that introduced invasive species pose the single largest threat to the survival of many of the threatened species and ecosystems (Department of Conservation 1999). Since the arrival of human settlement, New Zealand has gained 31 species of exotic mammals 24 of which have become major pests, such as the possum, rabbit, stoat and deer (Parliamentary Commissioner for the Environment 2000: 21). Two hundred species of invasive weeds have been introduced with the rate of invasion increasing to around eight species a year in recent decades and more recently microorganisms and insects have been arriving in increasing numbers (Parliamentary Commissioner for the Environment 2000: 38). New threats add to the presence of already well-established invaders that remain at large (Table 5.3; Box 5.3).

New Zealand's geographic isolation and absence of mammals (other than species of bats) led to the evolution of ground-dwelling birds that filled niches characteristically occupied by small mammals on the continents. Of the country's 2,350 native plant species, approximately 80% found naturally nowhere else and the unique species are particularly vulnerable to predation from humans, feral cats, rats and other mammals, while native vegetation is vulnerable to introduced browsing animals, such as deer and feral goats, as well as to competition from invasive weeds. Over 8,000 marine species have been recorded, including 84 seabirds, 52 marine mammals, 1,200 fish, 2,000 molluscs, 300 sponges, 400 echinoderms, 900 seaweeds, and 700 micro-algae (OECD 2007).

Subject to there being effective means of detection and capture or control, new arrivals can be exterminated if detected while the population remains concentrated.

Table 5.3 The more common and most invasive species in New Zealand

Invertebrates	**Plants**
German wasp	Acacia species (Mostly Australian)
Varroa destructor mite	Banana passionfruit
Sea squirt	Barberry
Fish	Blackberry
Grass carp	Boneseed
Gambusia	Broom
Rudd	Californian thistle
Catfish	Cape tulip
Trout	*Didymosphenia geminata* – didymo or rock snot
Mammals	Japanese Honeysuckle
Deer	Gorse
Ferret	Heather
Goat	Kahili Ginger
Hedgehog	Lodgepole Pine
Mouse	Lupin
Pig	Mexican daisy
Possum	Mistflower
Rabbit	Oxygen weed
Rat	Old man's beard
Stoat	Pampas grass
Himalayan tahr	Purple loosestrife
Weasel	Ragwort
	Rhamnus alaternus
	Rhododendron ponticum
	Scotch thistle
	Wandering Jew
	Yellow flag

In the case of some long established exotics, eradication can be an ongoing challenge despite half a century or more of concerted efforts especially in the case of small, prolific breeding mammals such as the possum, rat and rabbit (Isern 2002). The rabbit, for example, was the first introduced mammal to be identified as a pest. As early as the 1870s, the rabbit had rendered substantial tracts of pastoral land unproductive and gave an easy food source for predators that prey on native fauna. Legislation establishing rabbit districts and empowering the appointment of inspectors followed in an effort to eradicate the pest. From the outset, different opinions existed as to the wisdom of trying and the most appropriate method to be employed. The eradication options have since expanded but disagreement over which should be employed continues. In the late nineteenth century, the debate was between those who wanted mass extermination, those who wanted to develop rabbit as a cash crop and those who saw eradication efforts as futile arguing that only closer settlement by agriculturalists would be effective (implicitly blaming the rabbit nuisance on large scale pastoral farmers). In the 1990s, debate centred on the acceptability of introducing calicivirus (now known as rabbit haemorrhagic disease) as a disease-based control measure.

Box 5.3 Discussion Point: Weeding Out Our Future (Source: Landcare Research 2005)

In the 200 years since European colonisation, about 25,000 exotic species have been introduced to New Zealand. One of these exotics establishes a self-sustaining wild population (naturalises) about every 40 days. There are now more naturalised species than native species. In a short time New Zealand's flora has doubled. Currently, about a quarter of the naturalised flora are weeds, with 200 species controlled under legislation. These weeds are costly. Losses to agricultural and forestry production exceed NZ$1 billion annually. Environmental damage is huge but difficult to measure exactly. One estimate suggests more than NZ$2 billion annually.

The outlook is gloomy for a number of reasons. First, few naturalised species have reached their potential range and abundance in New Zealand. Even long-established species like gorse and broom are still spreading. Second, long-lived exotic species can take tens to hundreds of years to realise their damage potential as weeds. Third, we do not learn from earlier mistakes. For example, climbing spindleberry was known to exist in only one locality in 1988, but no proactive action was taken. It soon spread and the opportunity for eradication was lost. Fourth, we are our own worst enemies, since most new environmental weeds are garden escapees.

Critical thinking question: What methods can be used to control weeds?

Government ruled against this, influenced mainly by the risk to the country's environmental image from the presence of a contagious animal disease. Grassland ecologists supported the ban believing that merely removing the rabbit would not reverse the degradation of grasslands. Frustrated farmers ignored both perspectives and illegally smuggled in the disease and released it in Central Otago in 1997 in a major breach of New Zealand's biosecurity defenses (Parliamentary Commissioner for the Environment 1998). Once present, the government relented and has since allowed regional councils to import the disease although its effectiveness was not as great as expected. Rabbit numbers have fallen since 1997 but some rabbit populations are resistant to it, and others are becoming increasingly resistant (OECD 2007).

Overall it has been claimed that the response to invasive species in New Zealand that threaten native biodiversity has been minimal (Craig et al. 2000). The control of invasive species involves their eradication or their containment within a specified area. There are four categories of control. The decision as to which specific control technique to apply depends on the type of habitat, characteristics of the organism, the spatial dimensions of the spread, time available to dedicate to control, and cost.

- *Mechanical control* involves the removal of invasive species by hand or with machines. This approach is often most effective in controlling small populations that can be readily targeted, thus minimising harm to non-invasive plants and animals. Examples of this category of control method for plants include hand pulling, mowing, girdling (removal of tree bark), and burning. Examples for invasive animal control are hunting, trapping, and the construction of physical barriers like fences or nets. Mechanical control is usually labour intensive and requires a large time investment, as treatments must often be applied several times to ensure success.

- *Chemical control* uses chemical compounds applied over small or large area to prevent invasive species spread. Herbicides can be applied directly to a plant, in the soil at a plant's base, or to the soil before seeds develop. For invasive animals, pesticides or poison baits are used to restrict growth and reproduction or to kill the pests. Pesticides, such as rotenone, can be used to manage fishes and other aquatic organisms. For insects, attractant pheromones can be to lure mate-seeking insects into traps. Undesirable side effects of this method include contamination of land and water resources and by-kill of non-target plant and animal species. Over time the target species may develop a resistance to the chemicals.
- *Biological control* involves the release of a selected species to restrict the spread of the invasive species. For example, predatory insects can be released to feed on weeds and control invasive plants, or plants can be infected by disease causing organisms, such as fungi, bacteria, and viruses, killing them or reducing their ability to reproduce. Another approach involves releasing sterile males of the invasive species so that after mating a female will lay infertile eggs or eggs that will develop into sterile adults. One problem associated with this method is that the species selected for release is not usually a native organism, increasing the possibility of even more invasive species.
- *Prevention*. New Zealand biosecurity laws are designed to limit the entry of invasive species into the country thorough quarantine regulations, border controls and inspections of international shipments. Educating the general public so that they can participate in invasive species prevention is part of this strategy.

Control of established invasive animal pests remains problematic. The range of poisons used to control possums and rodents includes the anticoagulants brodifacoum, dipahacinone and pindone, and the acute poisons 1080 and cholecalciferol (Gillies 2001). Since the late 1990s, 1080 has become the most widely used poison, as it does not bio-accumulate. New Zealand is the only country in the world to apply 1080 poison from the air over large areas of land. Large quantities are used annually. Complaints by the public over the widespread use of 1080 led authorities to adopt a process of consultation with landowners and other stakeholders before drops of the poison are made. Controversy over the use of the toxin has nonetheless grown. In 2002, the Environmental Risk Management Authority launched a reassessment process to determine whether its use for pest control should continue to be permitted and while it allowed continued use it recommended that the search for less toxic options to 1080 should be encouraged. The Parliamentary Commissioner for the Environment (2011) has endorsed continued use of 1080 poison as the only practical option for controlling biodiversity threats in remote locations. Alternatives such as supporting possum hunting for fur or using sophisticated trapping devices that can be left in remote locations for long periods are considered impractical.

5.4.2 Biosecurity

The sensitivity to biosecurity risks has been heightened by importance of protecting commercial agriculture and the growth in international trade and movements of people bringing in exotic species as 'hitchhikers'. Examples include Asian gypsy moth egg masses carried by imported used vehicles from Japan, snakes carried inside shipping containers, mosquito larvae carried in water lying inside used car tyres, forest pests in timber shipments and dunnage, fungi and nematodes in attached to shipping containers and hulls. Intensive efforts to keep alive remnant species go on while invasive plants and animals threaten ecosystems on a broader front (Box 5.4). As a small country removed from the political conflicts affecting many parts of the world, biosecurity assumes much greater importance to New Zealand than security from terrorists. The flora and fauna of islands, after millions of years of geographical isolation and specialisation, often have lower competitive attributes than more aggressive plants and animals from continental environments (Wilson 2004).

Box 5.4 Case Study: Argentine Ants (Source: Landcare Research 2000)

Argentine ants are one of the world's most invasive and problematic ant species. They are aggressive and they bite humans, although they are not poisonous. They occur in huge numbers in high density clusters, up to six nests per m^2. Unlike other ant species, Argentine ant colonies co-operate and known to combine over winter into super-colonies. They are capable of eliminating other types of ant colonies and decimating other insect species and earthworms. They tend and protect populations of aphids and scale insects on plants, using them as a source of honeydew for food.

Argentine ants were first found in Auckland in 1990. Subsequently, they have been found in many parts of the New Zealand, including on Tiritiri Matangi, a high profile conservation island. Although they breed rapidly, they do not fly off to establish new colonies, which means they do not spread rapidly. A typical rate of advance is a few hundred metres per year. However, their nest can be transported by humans, most often when a potted plant is moved with a nest in its soil, or by nests set up in vehicles.

In parts of the United States Argentine ants are now considered to be one of the country's worst household pests. They eat most types of food. Their huge numbers and enormous appetite make them a serious pest. They are adept at finding their way into refrigerators and covered food containers. The ants are aggressive and kill or drive away other insects. They can climb trees and can kill young birds confined to nests. The ants compete aggressively with insects and birds that feed on honeydew or nectar. Argentine ants are a threat to agriculture as they feed directly on fruit tree flowers and fruit crops.

(continued)

Box 5.4 (continued)

They are one of the worst pests of citrus in Australia, and a serious pest of viticulture, avocado and tomato crops. As Argentine ants are not found in some Asian countries, if they become established in New Zealand's horticultural areas and near our export ports, they may affect New Zealand's ability to trade with those countries.

Response options: declare the Argentine ant an Unwanted Organism under the Biosecurity Act; develop a National Pest Management Strategy; monitor nationwide; eradicate isolated infestations; bait problem sites (e.g. landfills, reserves); public education on what to do and who to contact about the ants; better inspection of imports (e.g. containers, vehicles, produce); prompt responses to eradicate newly discovered infestations.

Critical thinking question: How would you rate the response priorities?

Biosecurity through control of introduced pests, both plants and animals, along with active pest management is held by some to the top priority in protecting New Zealand's unique biodiversity on the conservation estate. Many of the worst plant and animal pests in New Zealand appear as perfectly innocuous, even appealing, in other countries. Given the enormity of past impacts and the great potential of future potential impacts of serious biosecurity incursions, it is easy to appreciate why high standards of biosecurity are critical for New Zealand. In 2001, the New Zealand Reserve Bank estimated that a foot-and-mouth disease outbreak could cost the economy \$10 billion over the short-term, cost thousands of jobs and set back the economy for an extended period.

Biosecurity is not simply an end in itself, as it achieves multiple outcomes, both direct and indirect, such as market access for New Zealand's products, protecting the integrity of native ecosystems and the character of local landscapes. Biosecurity activities include reducing the risks posed by other countries through activities such as developing standards and regulations, stopping pest and disease at the country's borders and eradicating or managing introduced pests and diseases that have escaped detection and become established in New Zealand.

5.5 Māori

Māori tribes are important managers of environmental assets, both as landowners and as owners of resource rights. Approximately 80% of indigenous forest is on land owned by Māori, and Māori land covers about 15,000 km^2 (5.5%) of New Zealand's land area (OECD 2007). The Convention on Biological Diversity recognises the rights of indigenous peoples such as New Zealand Māori. Various environmental laws acknowledge Māori rights to care for the environment and use its resources including fishing, forests and traditional foods, as required by the 1840 Treaty of Waitangi (Chap. 3). However, there is little recognition of traditional ecological knowledge and environmental responsibilities (Craig et al. 2000). Some agreement has been reached for joint control with government agencies over the harvesting of customary resources such as *titi* (mutton birds), whale bone, *pounamu* (jade), and freshwater fish, as well as shared management of *taiapure* (traditional fishing grounds). Based on co-management experience in Australia and Canada, Craig et al. (2000) saw opportunity for greater application of traditional knowledge in the sustainable management of the resources and biodiversity within protected areas. of the public conservation estate has been missing.

The 2005 values survey found that 44% of New Zealanders are in favour of returning land, fisheries and other resources to Māori where injustices have occurred (Rose et al. 2005: 9). Widespread public opposition to Māori gaining the ability to seek title over the foreshore and seabed suggests that the acceptance of Māori influence is considerably less than this (see Chap. 7). There are several origins to this suspicion.

Some see a clash between western views of the environment informed by scientific sources of knowledge and 'other ways of knowing' (Broomfield cited in Young 2004: 216). Whereas empirical science respects that which can be observed and measured, aspects of Māori belief focus respect on the unseen (Young 2004: 216). Perhaps more influential than the different philosophical traditions are the expectations linked to the Treaty of Waitangi that Māori would retain the full, exclusive and undisturbed possession of their lands, estates, forests, fisheries and other properties. Māori expectations with respect to the environment are concerned centrally with obtaining a greater degree of Māori self determination (tino rangatiratanga) through ownership and control of the environmental resources that they were wrongly disposed of. The desire for redress is an aspect of the extent to which attachment to land is central to Māori cultural identity. As expressed by one researcher who is of Māori descent:

> Every aspect of life for Māori could be anchored into the land, as mana whenua [the right to claim land through genealogy, occupation, use or conquest] was exercised within a long-standing continuum of generations that, together, attached specific tribes, hapü, and other kinship units to specific localities (Keenan 2002: 250).

At the same time, the willingness of other New Zealanders to support the return of environmental assets to Māori management and ownership is affected by concern that different priorities exist with regard to the use of the environment. Given diversity among Māori and the tendency for values to be affected by contemporary conditions, rather than being inherited without reinterpretation, some caution is required in seeking to outline a Māori perspective. Nonetheless, traditional values that continue to inform Māori conceptions of sustainable development have been identified (Table 5.4). Particularly with regard to the strong sense of environmental stewardship and obligation to pass on to future generations what has been inherited from the

Table 5.4 Māori values relevant to sustainable development

Te Aoturoa – emphasises the interdependence with the natural environment, the cosmological relationship and responsibilities of Māori in relation to the whole and parts of the environment.
Taonga tuku iho – the notion of recognising and holding on to the treasures (taonga) and knowledge passed on from ancestors. Includes preservation of natural resources as well as cultural practices and knowledge of whakapapa (genealogical descent).
Kaitiakitanga – stewardship or guardianship of the environment.
Turangawaewae – having a place of standing, belonging and security.
Tau utuutu – acts of always giving back or replacing what you take or receive.
Whakakotahitanga, kotahitanga – respect for individual differences and the desire to reach consensus, unity and solidarity.
Mana Whenua, Mana Moana – legitimacy to control, manage and administer land, water and marine resources.

Source: Harmsworth et al. (2002: 46)

past, there is much in the Māori world view that accords with a strong environmental sustainability perspective (Pratt and Lowndes 2005). Indeed there are many examples where iwi and the Department of Conservation have formed partnerships, ranging from the protection and acknowledgement of New Zealand's highest peak (Aoraki or Mount Cook), sacred to Ngai Tahu, to giving Ngati Koata no Rangitoto kit e Tonga a special role in the management of a small offshore island (Takapourewa or Stephens Island) that has been repopulated with tuatara, New Zealand's indigenous prehistoric lizard (Young 2004: 218). As well some innovative ways have been found to accommodate traditional practices with conservation such as the development of protocols that allow designated Māori to harvest species that have died in accidents or strandings and to use trees that have been felled through natural processes. For example, within part of the Hauraki Gulf Marine Park, stranded whales may be harvested to obtain meat and bone for carving.

For non-Māori environmentalists who support a strong version of sustainability, the assertion of ownership rights over the environment can demonstrate an unacceptable claim to human dominion over the environment (Wallace 1997). This concern was expressed in relation to the flora and fauna claim (Wai 262) to the Waitangi Tribunal. This claim asserted indigenous rights (tino rangatiratanga) under Article Two of the Treaty of Waitangi over the protection of biological resources, including genetic resources that claimants alleged had been usurped by the Crown. The claim was criticised as consistent with a private property rights paradigm that 'is ecologically nonsensical and ultimately dangerous to our and other species' survival' (Wallace 1997: 102). In the event the report of the Waitangi Tribunal on the Wai 262 claim made recommendations that did not envisage any shift toward privatisation of the environment. Rather the broader direction of the recommendations was to encourage greater commitment to a partnership between the Crown and Māori as the mechanism for ensuring that Māori would be able to exercise their guardianship of the elements in and about the environment that are important to them (Waitangi Tribunal 2011a). This is expressed in terms of the ability to exercise an inherited responsibility rather than as an assertion of rights.

The Wai 262 judgement, for example, recommended amendments to the Wildlife Act to indicate that management of protected wildlife should be shared between the Crown and Māori, and that no one ‘owns’ protected wildlife (currently, the Crown owns protected wildlife) (Waitangi Tribunal 2011b). Regarding laws and processes relating to patents and plant variety rights, the Tribunal recommended establishment of a Māori advisory committee to the Commissioners of Patents and Plant Variety Rights about whether inventions are derived from Māori traditional knowledge or use taonga (treasured) species. Among related recommendations it suggested granting the Commissioner of Patents the power to refuse patents that unduly interfere with the relationships between kaitiaki (guardianship) and taonga; and introducing a legal requirement for patent applicants to disclose any Māori traditional knowledge used in research. The establishment of new national and regional partnership structures to give Māori an equal voice with the New Zealand Conservation Authority and regional conservation boards in setting conservation objectives and priorities was also called for.

The relationship between Māori and non-Māori conservationists remains problematic. The way that Māori campaigned against the introduction of genetically modified organisms and in so doing achieved particular influence over the recommendations of the Royal Commission on Genetic Modification (2001) has been viewed as a sign that Māori concerns are becoming more respected (Young 2004). The report on the Wai 262 claim has many practical recommendations that if acted upon could bring greater understanding of Māori perspectives as well as their greater involvement in resource management.

5.6 Conclusion

This chapter has highlighted that New Zealand’s performance is far from exemplary as far as managing the land is concerned. Human settlement of New Zealand took place only relatively recently, but the environmental changes that resulted were dramatic. A land of forests was turned into open pastures, villages and towns. But not all of New Zealand’s current environmental problems on land are those inherited from these past changes. The effects of more recent and on-going activities are of growing concern. Often they appear individually small but are cumulatively significant.

The main pressures on biodiversity are insufficient habitat in lowland areas, declining quality of many of the surviving habitats, the impacts of pests and weeds. The main responses to biodiversity decline have focused on ecosystem and species recovery programmes on offshore islands and extensive pest control operations on the mainland, but the need for partial restoration of representative indigenous lowland and coastal ecosystems has yet to be addressed adequately. Pest control, especially of possums, is critical if New Zealand’s native plants are to be protected.

The main pressures on soil are from past deforestation of land susceptible to erosion, localised accumulations of harmful chemicals or waste products, and the impacts of over-cultivation or overstocking on erosion-prone and compaction prone land. Soil conservation has, up until now, been considered the land user's responsibility. The main land-use issues are: ecosystem stresses and declining biodiversity caused by habitat fragmentation in agricultural and urban areas; damage by animal pests and the impacts of introduced plant species on native ecosystems, crops and livestock; soil degradation due to by the impacts of farming and loss fertile land to urbanisation; loss of wetlands to land drainage; and contamination of waterways by run-off from farms, urban streets and subdivisions, and industrial discharges.

Study Guide

End of Chapter Summary

5.1 The original lowland forest of the North Island has been reduced to isolated fragments, leading to forest ecosystems being highly susceptible to degradation including a reduction in species diversity. Plantation forests have limitations as habitat for native animals, most obviously in the periodic felling of mature trees.

5.2 The main pressures on soil are from past deforestation of land susceptible to erosion, localised accumulations of harmful chemicals or waste products and the impacts of over-cultivation or overstocking on erosion-prone and compaction prone land. The effects of soil erosion from farmland are twofold: a valuable resource is lost from the farm and the downstream effect of eroded sediment entering waterways is enormous.

5.3 New Zealand has a long history of setting aside land for conservation and recreation but until recently this has mainly protected wilderness areas. Proposals to open up more Schedule 4 land for mining have been seen as a threat to the conservation estate although invasive species are the most pervasive risk to native flora and fauna. In 2010, the Minister of Energy and Resources was given a role in determining permits for mining and access to the conservation estate.

5.4 Most biodiversity conservation in New Zealand to date has focused on individual species, but there is growing awareness of the importance of functional diversity and not just species richness in maintaining the integrity of ecosystems. There are four categories of control of invasive species: mechanical, chemical, biological and prevention. Biosecurity through control of introduced pests, both plants and animals, along with active pest management is held by some to the top priority in protecting New Zealand's unique biodiversity on the conservation estate.

5.5 Legislation acknowledges Māori rights to care for the environment and use its resources including fishing, forests and traditional foods, as required by the 1840 Treaty of Waitangi. Settlement of Treaty claims is resulting in environmental management partnerships between state agencies and Māori as well as transferring land ownership.

Discussion Questions

How has human settlement of New Zealand resulted in environmental degradation?
In what ways and to what extent is soil degradation an environmental problem in New Zealand?
How could the environmental benefits of exotic forestry be maximised?
What makes the control of invasive species so difficult in New Zealand?
What makes public ownership of the conservation estate a less effective contribution to environmental management than it might be another country?
What environmental and non environmental criteria would you recommend be used to determine the acceptability of mining on conservation land?
What are the barriers to high country farmers in the South Island becoming land owners in place of being lease holders?
What arguments support an extension of Māori involvement in the management of conservation land?
What recommendations made in the Waitangi Tribunal judgement on the Wai 262 claim would you like to see enacted?

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Chapter 6
Freshwater

Key Questions

- What impact have people had on New Zealand's water flows and water quality?
- What is nutrient contamination and how serious is the problem in New Zealand?
- What are the main environmental pressures on the flow of freshwater in New Zealand?
- What is the state of New Zealand many large and small lakes?
- What is New Zealand's environmental performance record like as far as managing freshwater is concerned?
- How successful have coordinated efforts been to improve water management practices in New Zealand?

Abstract Freshwater and freshwater aquatic ecosystems are key features of New Zealand's natural heritage. They are of particular practical and spiritual value for Māori. Water resources are essential to the nation's economy and are a significant recreational resource. Plentiful precipitation feeds many hundreds of streams, over 70 major rivers, about 770 lakes and numerous underground aquifers containing cool groundwater or hot geothermal water. Largely through the influence of mountain ranges, precipitation is unevenly distributed across the country. Ample precipitation has facilitated the development of hydroelectricity, but the more suitable sites are now either utilised or affected by conflicting land use and conservation demands. Land-use intensification is placing great pressure on freshwater environments and on the ecosystems on which much of New Zealand's biodiversity depends. Poor water quality is found in catchments dominated by intensive agriculture or urban land use. Good riparian zone management is a key factor in determining water quality of streams in rural areas, in particular, streams bordering on pastoral land.

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Key Concepts and Terms Dairying and Clean Streams Accord • Deforestation • Drainage and channelisation • Draw-off for irrigation • Point and non-point discharges • *E. coli* • Ecosystem monitoring • Eutrophication • Faecal contamination • Groundwater • Impact of forestry on streams • Land drainage • National River Water Quality Network • Native forest • Nutrient contamination • Nitrogen fertiliser • Oxidised nitrogen • Phosphorous • Plantation forest • Potable water • Riparian zone • River habitats • Sedimentation of dams and waterways • Sedimentation in steep catchments • Shallow lakes • Taupo-Nui-a-Tia Action Plan • Urban sewage • Urban stormwater • Waste discharge

6.1 Conceptual Overview

Freshwater is a renewable but finite resource. Typically, it is assumed that with time, demand for the resource will grow and that the natural resource base is constant. Conventionally, it is also assumed that the future resource base will be similar to that of the past. Given the inevitability of climate variability imbedded in ever changing climate along with the possibility the resource may be degraded by pollution, these assumptions are deceptive. Adaptation to changing conditions in water availability, water quality and demand has always been at the centre of environmental management of water. Essentially, water management is based on minimization of risk of supply and maximisation of water quality. In environmental management, the focus is usually on the latter.

A wide range of adaptive options are available to water managers faced with changing circumstances. One widely used classification distinguishes between 'supply-side' and 'demand-side' options (de Freitas 2009). Examples of supply-side options are: prospecting and extraction of groundwater; increasing storage capacity by building reservoirs and dams; expansion of rain-water storage; water transfer; desalination of sea water; and removal of invasive non-native vegetation from riparian areas. Examples of demand-side options are: improvement of water-use efficiency by recycling water; reduction in water demand for irrigation by changing the cropping calendar, crop mix, irrigation method, and area planted; reduction in water demand for irrigation by importing agricultural products; promotion of indigenous practices for sustainable water use; expanded use of water markets to reallocate water to highly valued uses; and expanded use of economic incentives including metering and pricing to encourage water conservation (Kundzewicz et al. 2007; de Freitas 2009).

Supply-side options focus on increasing capacity, while demand-side options focus on managing demand and changing institutional practices and operating rules for existing water resource systems. From the supply side, freshwater shortages occur virtually everywhere from time to time. From the demand side, agriculture and industry are the major users of water. Population growth, agricultural expansion, and demand for water by a growing industrial sector are likely to make water shortages as well as the inevitability of declining water quality even more common in coming years.

Another approach distinguishes between (1) technological, (2) behavioural, (3) economic, and (4) legal measures to manage freshwater (de Freitas 2009). They are described briefly as follows.

Technological measures include (a) increased efficiency, (b) recycling, and (c) redistribution. Increased efficiency aims to extend water resources. The largest gains will be made in agriculture and industry, which are the biggest water users. Given that, in agriculture, irrigation accounts for most of freshwater used in New Zealand, micro-irrigation, or drip irrigation, is a good example of extending the resource. Recycling is often the next most cost effective management response. Used water can be purified and reused in industry, on farms and domestically. "Gray water" is untreated or semi treated wastewater that can be cheaply used for such things as irrigating golf courses, lawns, parks and gardens in urban and suburban areas. It is also effective in recharging groundwater storage. Recycling the same water during production is an example of a design change from improved technology that can save large amounts of water. Through improved technologies, for example, wastewater may be recycled or 'reclaimed' in what is called "closed loop reclamation" through the 3Rs of 'return, repurify and reuse'. Water recycling also reduces water pollution. While such changes may temporarily increase costs, they ultimately lead to increased savings as the price of steadily decreasing water supply rises. Redistribution involves the use of dams and reservoirs to store water in times of surplus and allow it to be used in times of deficiency, as well as facilitating redistribution of water to water deficit regions via canals and pipelines. Dams and reservoirs can have significant environmental and social impacts. They can reduce or eradicate native fish, impede fish migration routes, flood wildlife habitat and agricultural land, displace communities, diminish nutrient flow to estuarine habitats.

Behavioural measures involve conserving water by changing human behaviour, such as switching to crops with low water needs or adopting farming methods that are more water efficient, especially high water-use and potentially highly polluting activities such as dairy farming.

Economic measures focus on the cost of water. When water resources are inexpensive, or there are no financial incentive to conserve, recycle or substitute water use, economic policy instruments can be employed to change this, usually through market forces. The largest gains will be made in agriculture and industry, which are the biggest water users. Currently, farmers have little incentive to conserve water, especially in dairy farming that uses large quantities of water, as well as that used in irrigation where vast quantities are lost though evaporation. Taxing water use in agriculture, industry and households is a means of re-valuing it as a commodity to encourage conservation. Taxes can be levied as effluent charges, which is not only an incentive to conserve water, but also reduces pollution.

Legal measures involve passing laws regulating the use of water to control and extend its use. Even in times of normal precipitation, excessive use of ground and surface water for prolonged periods can cause streams and wetlands shrink or dry up, with profound ecological effects. Legal control is easiest for surface waters, which is the easiest for policing authorities to monitor. Problems of detection explain why unsustainable depletion and pollution of slow moving groundwater is so widespread globally. The former dictates that governments can appropriate water for general use, such as water from large rivers diverted for dams or irrigation. Riparian laws apply to owners of land who have the right the withdraw water from rivers and lakes bounding their land, but on condition that the water is returned to its source in an unpolluted state. By and large, legal measures are best used in circumstance where only a small number of actors use the resource (to enable controls to be focused on specific threats) and where stricter controls are required than can be provided by market controls.

6.2 The Water Resource Base and Pressures on It

Total annual precipitation in New Zealand is between 300,000 and 600,000 million cubic metres. It has been estimated that New Zealand's consumption of water approaches 2,000 million cubic metres per year (Statistics New Zealand 2006). Households use 210 million cubic metres, industry 260 million cubic metres, livestock 350 million cubic metres, and irrigation 1,100 million cubic metres per year. Approximately 87% of the population is supplied by public water supply systems. The rest rely on a self-sufficient domestic supply such as rainwater collection and aquifer bores. Industry obtains about 33% of its water requirements from public supply systems and 66% from its own sources. These figures do not include the use of water for hydro-electric generation, which exceeds 100,000 million cubic metres per day (Statistics New Zealand 2000). On average, each New Zealander uses about 160 L of freshwater per day, excluding water used for hydroelectricity, irrigation and industry. If these three big users are included, then consumption increases to 82,000 L of water per person per day (Ministry for the Environment 2006).

Freshwater is a renewable resource but because it is limited, it has to be allocated among users. Until relatively recently, water has never been considered a scarce resource in New Zealand, consequently the economic and regulatory aspects controlling its allocation and use have been neglected. Although the intensity of water use in New Zealand is one of the lowest among OECD countries, per capita water extraction rate is almost three times higher than the average for OECD counties, reflecting the importance of water use for irrigation and hydroelectricity generation (OECD 2007).

Irrigation is the biggest user of freshwater in New Zealand, accounting for 77% of all allocated freshwater, compared to the worldwide figure of 70% (Landcare Research 2010). Around 80% of New Zealand's freshwater (excluding that used for hydroelectricity) is used by agriculture for irrigation (Ministry for the Environment 2007). An agricultural census in 2002 revealed that ground and river water was used to irrigate half a million hectares of land. The biggest user by region was Canterbury which has 61% of the irrigated land, followed by Otago (15%), Marlborough (4%) and Hawke's Bay (4%). In January 2006, Environment Canterbury reported the lowest level of ground water ever recorded in aquifers beneath the Canterbury Plains.

Table 6.1 Sources of impacts on water quality as rated by officials in a survey by the Ministry and Agriculture and Fisheries, ranked on a scale from 0 = no damage to 10 = severe damage

Source of impact	Average rank
Agriculture	4.9
Human sewage	4.8
Urban storm water	3.9
Industry	3.8
Agricultural processing	3.7
Mining	2.6
Forestry	2.6

Source: Sinner (2011) and Ministry for the Environment (1997)

Table 6.2 Types of agricultural impacts on water quality as rated by officials in a survey by the Ministry and Agriculture and Fisheries, ranked on a scale from 0 = no damage to 10 = severe damage

Type of impact on water quality	Average rank
Sedimentation	6.4
Nutrient contamination	6.2
Alteration of physical characteristics	5.6
Faecal contamination-surface water	5.4
Nitrate contamination-ground water	4.6
Pesticide contamination-surface water	2.8
Faecal contamination-ground water	2.8
Pesticide contamination-ground water	1.6

Source: Sinner (2011) and Ministry for the Environment (1997)

Between 1985 and 2002, irrigated land in New Zealand increased from 2,600 to 4,675 km^2, or 10% per year. Most of this increase (67%) took place in the Canterbury region, where the area under irrigation almost doubled in the period between 1985 and 2002 (from 1,500 to 2,900 km^2) (OECD 2007). Farmers used to regard irrigation as backup for dry periods, whereas now they use it to keep soil moisture at or near field capacity so as to increase grass growth and allow higher stocking rates on pastures. With this growing demand, it seen as an imperative that a policy of water resource pricing is introduced to optimise water use among users and use efficiency, especially during shortages.

With such a variety of water uses and high volume of consumption, it is not surprising that people have had an impact on New Zealand's water flows and water quality. The greatest impacts, however, have not come from water use, but from land use. Sources of impacts on water quality as ranked by regional officials are given in Tables 6.1 and 6.2. The main land use activities and their impact are:

- Agriculture: vegetation clearance, land drainage and channelling, draw-off for irrigation and stock watering, and run-off and waste discharges from farms and agricultural processing facilities

- Urban: sewage, industrial waste, stormwater run-off, draw-off for household and industrial uses, and urban expansion into wetlands and estuaries
- Dams (including hydro-electric and water supply dams): sedimentation, disruption of river habitats; loss of land through inundation
- Mining: run-off and waste discharge from open cast mines and road access
- Forestry: little impact (shading of streams, acidity of water, runoff from unsealed access roads)

Landform type is an important intervening consideration. For example, small, shallow lakes or streams are more susceptible than large, deep lakes and rivers. Contamination can arise directly from point sources of pollutants, such as from drainage channels and pipes, or from diffuse areal or non-point discharges, such as nitrate leaching from animal urine patches and runoff from pastures.

6.3 Managing Freshwater

Management of freshwater, including groundwater and geothermal water, is the responsibility of the country's 17 regional authorities (12 regional councils and 5 unitary councils) the boundaries of which are demarcated by watersheds. Central government also plays a part. Under the Resource Management Act (Chap. 3), the regional authorities are "required to safeguard the life-supporting capacity of waters and ecosystems and ensure that water users avoid, remedy, or mitigate any adverse effects of their use on the environment" (Ministry for the Environment 1997). The responsibilities of the regional authorities fall into three categories:

- Regulation of freshwater resources, including extraction, and diversion of water, placing structures on the beds and banks of lakes and rivers, discharging pollutants to water bodies and building of dams and flood control structures.
- Regulate pollutant discharges into coastal marine waters, and the impact of land reclamation and placing structures on the coast.
- Mitigate flood risks, soil degradation and erosion in water catchments.

Regional authorities define water management priorities in regional policy statements and plans and in regional coastal plans. The approach of regional authorities is to set environmental limits on water use and water quality standards are issued through policy statements, plans and water permits. They are also responsible for issuing impacts-based environmental permits, called "resource consents", for activities they regulate.

Under the Resource Management Act, there are three tools to guide regional authorities' management of water resources (OECD 2007):

- Water conservation orders for protecting "outstanding" water resources by prohibiting damming and restricting abstraction;
- Issuing national policy statements to encourage consistent approaches to water management among regional authorities; and
- By developing national environmental standards.

All resource consents issued by regional authorities must be consistent with the policy tools. The National Sustainable Development Programme of Action (2003) considered management of freshwater to be a major sustainability issue, and identifies three desired outcomes: (1) freshwater is allocated and used sustainably, efficiently and equitably; (2) freshwater quality is maintained to meet all appropriate needs; and (3) water bodies with nationally significant natural, social or cultural heritage are protected (OECD 2007). The programme was abandoned by a new government in 2009.

Given that maintenance of water quality is the responsibility of regional councils, controls placed on the activities that affect water quality, the environmental limits on water use and water quality standards are issued through policy statements, plans and water permits (Box 6.1). Since the late 1990s, New Zealand has made significant progress in reducing point source discharges, but has been less successful in dealing with non-point source discharges, mainly from runoff of animal wastes from pastures, fertiliser and sediments as well as runoff of pollutants from paved surfaces in urban areas, and point source discharges such as from industrial plants factories and sewage outfalls.

Box 6.1 Discussion Point: Problems with Wastewater Services (Source: Landcare Research 2005)

While wastewater services are all under public ownership, a mix of decisions by local authorities who manage them has created a diversity of pricing regimes and a lack of planning. For example, North Shore City, one of four city authorities in the Auckland region prior to the creation of the Auckland supercity in 2010, owns and operates its own treatment plants at Albany. Every day the average North Shore resident uses well over 200 L of treated water. Most of this flows to a site in Albany and has to be re-treated before it is released into the water of the Hauraki Gulf.

The Wastewater Treatment Plant at Albany was commissioned in 1962. It was designed for a population of 70,000 and situated in a once sparsely settled area of the North Shore. By 1991 the population of the North Shore had grown to 180,000 with the most rapid growth occurring in the vicinity of the Treatment Plant. Accentuating the problem, city planners allowed residential and commercial activities to occur closer to the plant's boundaries. As demands on the plant grew, so did the stench. Rather than establish a new plant well away from dense settlement, the North Shore City Council decided the solution to the problem was to upgrade and expand the existing facility. The decision was reportedly informed by the results of a survey of all North Shore residents who had been advised that the Albany site was the cheaper option among those existing in 1990. North Shore planners accepted the survey results despite the impact for Albany residents, reasoning that the improved technology should help reduce the smell.

Critical thinking question: What factors determine the location of wastewater treatment plants?

Most notable progress has been made in reducing point source discharges of human and agricultural sewage (especially dairy shed outfalls) and industrial waste into waterways (Ministry for the Environment 2004). Some the direct discharges have been dealt with by converting them to diffuse discharges, for example, land disposal of waste from urban areas and dairy sheds. But the more difficult and widespread problem of non-point source discharges has yet to be addressed and will require changes in land management, especially rural land management. Because approximately half of New Zealand's land area is under primary production, rural land uses have the ability to affect a large number of rivers, lakes and groundwater.

6.3.1 Efforts to Improve Water Management Practices

Most if not all major stakeholders in the industrial sector, as well as central and local governments, accept that much remains to be done to reduce further damage to the country's rivers, lakes and groundwater and to repair damage that has already occurred. Consequently, there have been numerous attempts to address this, but so far, real progress has been slow.

The Primary Sector Water Partnership created in 2008 aimed at bringing together major primary sector industries to improve water quality in New Zealand (in mid-2011 there were 11 members or "partners"). The stated goals of the partnership are: (1) Maintain and/or enhance water quality from primary production land, with demonstrable and accelerated progress on the resolution of water quality issues from agricultural land within 5 years; and (2) Demonstrable improvements in water use efficiency by the primary sector within 5 years (Primary Sector Water Partnership 2008). The idea is to draw together environmental initiatives from the various partners. The extent to which the Partnership has any authority is not clear. It appears the foremost aspiration is an effort to ensure all primary sector industries are in communication with each other on environmental issues.

The Land Water Forum formed in 2010 is a wider grouping that involves members of the Partnership, but also includes central and local governments, interest groups and iwi. Its aim is "to ensure that water will meet the ongoing cultural, economic, environmental, and social needs of New Zealand" (Land Water Forum 2010). As of September 2011, none of the Forum's recommendations had been implemented.

The National Policy Statement (NPS) on Freshwater Management was passed by the Government in May 2011. The aim of the NPS is to maintain or improve "the overall quality of freshwater in New Zealand". According to a Cawthron Institute report on the NPS (Sinner 2011), this means that some rivers and lakes can be further degraded as long as the regional council has plans for others to be improved. The report also states that already polluted lakes and rivers will only get worse under a flawed NPS water policy, because regional councils have been given too long (up to 30 years) to set pollution limits.

There has been some progress in establishing policies in the farming sector to improve water quality. A 'Dairying and Clean Streams Accord' was agreed to in 2003. It is a voluntary partnership that relies on the goodwill of the dairy farmers' dairy co-operatives to set and meet targets. So far progress has been erratic. On the positive side, both the 2007 target to exclude dairy cows from more than 50% of waterways and the 2012 target for bridging 90% of streams were achieved in 2006 (Box 6.2). On the other hand, very few dairy farmers have put in place systems to manage the amount of fertilisers applied to their land, with the exception of Hawke's Bay where about half the farmers had a nutrient limit in place by the end of 2005 (Ministry for the Environment 2006).

Box 6.2 Discussion Point: The Dairying and Clean Streams Accord (Source: Ministry of Agriculture and Forestry 2011)

Poorly managed dairy farming can severely damage the natural environment through water contamination by nutrient leaching and biological contamination, loss of wetlands, erosion and sedimentation build up in streams and rivers. The main mitigation responses are to keep cows away from waterways by fencing, controlling dairy shed effluent and tree planting to limit leaching. The Dairying and Clean Streams Accord is an environmental initiative set up to improve the dairy industry's environmental performance. The Accord set out five targets for dairy farmers: (1) cattle to be excluded from 50% of rivers and lakes by 2007, rising to 90% by 2012; (2) bridges or culverts to be constructed over 50% of regular crossing points by 2007, and 90% by 2012; (3) all dairy farm effluent discharge to comply with resource consents and regional plans with immediate effect; (4) all dairy farms to control nutrient inputs and outputs by 2007; and (5) fence 50% of regionally significant wetlands by 2005, rising to 90% by 2007. As of 2011, two of the five Accord 2007 targets had been met (dairy exclusion from waterways covered by the Accord; bridging and culverting of regular crossing points) which was no change from previous years.

There has been slow progress towards full compliance with regional council dairy effluent rules. Nationally, the level of full compliance dropped from 64% in the 2007/2008 season to 60% in the 2008/2009 but was up to 69% in 2010/2011. Among major dairying regions in 2010/2011, compliance varied from 95% in Taranaki to 42% in Southland and 40% in Northland. The Ministry of Agriculture and Forestry expressed concern that compliance with resource consents and regional plan rules for dairy farm effluent discharges remains poor in some regions. It as well notes that Fonterra has found it challenging to impose penalties on non complying farmers because of difficulty working out consistent penalties that take account of local circumstances.

Critical thinking question: What are the merits of the Dairying and Clean Streams Accord as compared to formal legislation?

6.4 Nutrient Contamination

Agriculture contributes to water pollution in the form of chemicals and microbiological contaminants, but the largest source of pollution of natural waters is nutrients, namely, nitrogen, ammonia, and phosphorus. Large amounts of fertiliser are added to the soil to maintain high productivity. When nutrients are applied to pasture and crops at a rate beyond which plants are able to assimilate, they will spread to the wider environment causing damage. The main source of environmental problems is pastoral farming (mainly dairying, sheep and beef cattle) because it is the major agricultural land use in New Zealand where pastures account for over 85% of the total farmed area (15.3×10^6 ha) (Hedley et al. 2011).

Faecal contamination from pastoral farming has the greatest influence on freshwater quality (Parliamentary Commissioner for the Environment 2005). Dairy farming is the main reason. In the decade 1996 to 2005, dairy farming was one of the fastest growing industries in the country. In 2005, dairy farms covered approximately 11% of all agricultural land and, since 1996, stock numbers have increased by 30% and average herd size by 50% (OECD 2007). A persistent problem in assessing impact is that agricultural runoff such as this is difficult to measure and control. Unlike point source discharges, non-point source discharges (such as runoff from pastures and hill slopes) are relatively complex systems to measure and control. Most agricultural sources of contamination are from non-point discharges.

Generally speaking, water quality in rivers and lakes has declined over the past decade in regions of the country dominated by pastoral farming, where high nutrient inputs and microbiological contamination damage natural ecosystems and create conditions that can affect human health. In lowland areas of New Zealand, surface waters regularly exceed national water quality guidelines; consequently, damage to aquatic ecosystems is widespread (OECD 2007).

6.4.1 The Special Case of Nitrogen

About 2.3 million tonnes of synthetic fertiliser were applied in New Zealand in 2002, of which 53% was phosphate, 33% nitrogen and 15% potassium (Statistics NZ 2006). The lead position of phosphate was soon to change. Since 2005, nitrogenous fertiliser (urea) has become the most commonly applied nutrient. The use of nitrogenous fertiliser in New Zealand climbed rapidly in the past 25–30 years as dairying became more intensive and stocking rates increased. Since 1996 growth in its use has exceeded GDP growth (OECD 2007). The use of nitrogenous fertiliser more than doubled in the decade following 1995. This increase is thought to have come about in part to offset a fall in nitrogen fixation from white clover resulting from infestation by the clover root weevil (OECD 2007). For example, in 1996, nitrogen made up 6% of all fertiliser use, which increased 13% in 2002. Around 54% of nitrogen fertiliser applied in 2002 was used in dairy farming, 19% in sheep farming, 8% in beef cattle farming, 4% in sheep-beef farming, 4% in vegetable growing and 2% in deer farming (Parliamentary Commissioner for the

Table 6.3 A comparison of agricultural indicators for OECD countries in 2005: use of nitrogenous fertilisers and pesticides, and density of livestock

Country	Use of nitrogenous fertilisers (t/km^2 of agricultural land)	Use of pesticides (t/km^2 of agricultural land)	Livestock density[a]
New Zealand	2.1	0.20	685
Canada	2.7	0.06	192
Korea	18.9	1.20	1,560
Australia	0.2	0.01	62
Netherlands	14.6	0.41	2,142
Sweden	6.0	0.05	409
Switzerland	3.5	0.10	794
OECD Europe	5.6	0.17	468
OECD	2.2	0.07	208

Source: OECD (2007)

[a] Figures are head of "sheep equivalent" per km^2 of agricultural land, based on equivalent coefficients in terms of manure: 1 horse = 4.8 sheep; 1 pig = 1 goat = 1 sheep; 1 hen = 0.1 sheep; 1 cow = 6 sheep

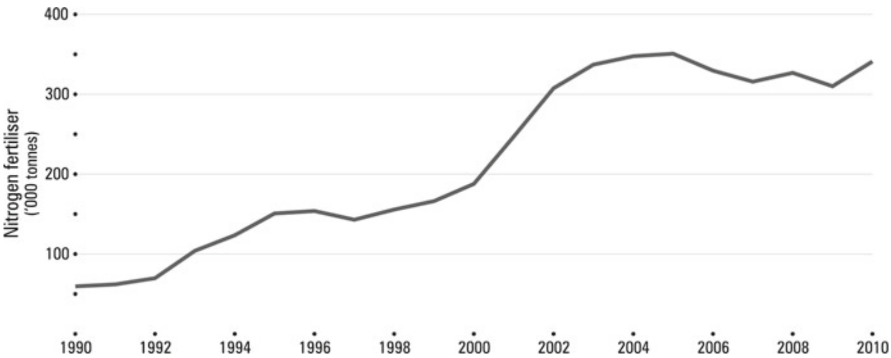

Fig. 6.1 Synthetic nitrogen fertiliser (urea) applied in New Zealand 1983–2010. Data assembled from Fert Research (2011), Hedley et al. (2011), Ministry for the Environment (2010) and Parliamentary Commissioner for the Environment (2005). Note: the fertiliser 'year' runs from June to May

Environment 2005). Although the amount of fertiliser used per hectare has increased, the level is well below the OECD average (Table 6.3). Figure 6.1 shows that in the period 1983–2010, application of nitrogen fertiliser to the land increased exponentially, but levelled off somewhat in recent times.

Once nitrogen is leached to the environment there is no effective way to remove it. This has given rise to one of the country's major environmental problems: nitrogen contamination of streams, rivers, lakes, and groundwater. However, it is important to note that the main sources of nitrate leaching in New Zealand by far are livestock urine and manure, accounting for more than 90% (Ledgard et al. 1999, 2005; Parliamentary Commissioner for the Environment 2005). Phosphorus is a nutrient that does not readily leach,

On average, only about 10% of the nitrogen in grass or silage is converted into milk, meat or wool. The remainder is excreted in dung and urine. As nitrogen fertiliser finds its way into lakes, especially shallow lakes, eutrophication occurs when too many nutrients enter a lake or stream and cause excessive growth of weeds and algae (phytoplankton). These can suffocate the oxygen-breathing organisms in the lake. Eutrophic lakes have low levels of dissolved oxygen, poor water clarity, nuisance algal blooms and fewer fish. More than 700 lakes in New Zealand are shallow and between 10% and 40% of these are nutrient enriched (eutrophic). More than 90% of the eutrophic lakes are in the North Island and in pasture dominated catchments, and a number are no longer capable of supporting fish life (Ministry for the Environment 1997). On a more positive note, the use of phosphorus fertiliser in New Zealand farming (another nutrient contributing to eutrophication) decreased by 19% between 1996 and 2002 (Parliamentary Commissioner for the Environment 2005). Since 1997, there has been a change at a regional level towards a more integrated approach to freshwater management (see Sect. 6.3).

The main sources of nitrogen leaching in New Zealand are livestock urine and manure. Environment Waikato (2005) has estimated that the waste generated by the 3,000 dairy herds in the Waikato River catchment is equivalent to the waste from five million people. Stock effluent is a source not only of nitrogen but also of microbiological contaminants such as faecal coliforms and campylobacter. Since 1996, most dairy shed effluent comprising wash water and manure is disposed of over land rather than directly to waterways, as a result of regulation under the Resource Management Act. A majority of regional councils no longer allow any discharge direct to waterways unless it has been through primary treatment.

6.5 Rivers

Generally speaking, New Zealand's rivers and streams surrounded by natural land use or exotic forestry have good water quality. There is also acceptable water quality in areas of low intensity agriculture such as sheep farming. Poor water quality is found in catchments dominated by intensive agriculture or urban land use. Good riparian zone management is a key factor in determining water quality of streams in rural areas; in particular, streams bordering on pastoral land (see Box 6.3). Urban and agricultural land use are predominantly found in lowland areas and lowland rivers suffer the most from poor water quality.

Box 6.3 Discussion Point: Riparian Zones in Crisis (Source: Ministry for the Environment 1997)

In their natural state most lowland streams were bordered by dense native forest packed with at least 50–100 species of trees shrubs, mosses and fungi. The riparian zones were home to almost half the native birds, many of which are now extinct or threatened, and also home to frogs, skinks and lizards, slugs,

(continued)

Box 6.3 (continued)

snails, flatworms, earthworms and nematodes, and many insect species. The overhanging vegetation and falling leaves and branches provided shade, food and habitat for a large variety of native fish. The shade also controlled algae levels and maintained cool water temperatures through summer. The tree roots limited bank erosion, keeping the water clear of sediment. Today, most stream banks have been cleared of their vegetation to create pasture. The rich diversity of the riparian zone has been replaced by just a few species of exotic grass and shrubs and the occasional tree. Loss of shade has increased light levels and water temperatures affecting the native fish and leading to an over abundance of algae and introduced weeds. The situation has been aggravated by run-off of nutrient-rich water from animal waste and fertilisers and sediment from eroding hillsides and collapsing streambanks caused by sheep and cattle.

There are now riparian protection measures in a few parts of the country, most notably the famous trout streams draining into Lake Taupo, which became riparian protection zones in the 1970s. However, this is an exception rather than the rule. Where bank erosion has caused serious pasture loss, some farmers have planted willow and poplar trees which with their fast growth rates can quickly restore bank stability. A downside is that some species (especially water-loving willows) invade the streams channels and disrupt habitats for aquatic life. On the positive side, a number of local councils are now promoting riparian retirement planting and conservation.

Critical thinking questions: Why are riparian zones so important? Why has this important aspect of rural land management been neglected for so long in New Zealand?

The main environmental pressures on the flow of freshwater in New Zealand have been from:

- Drainage and channelisation, which have reduced wetlands and altered the natural character of rivers including lowland aquatic habitats
- Deforestation, which has intensified flooding and sedimentation in steep catchments
- Increasing demand for urban water supplies, livestock and irrigation

Responses to these pressures on water flow are directed at increasing the supply of drinking and irrigation water, but the main environmental focus is the water catchment as a whole involving re-forestation and water conservation.

The quantity of nutrients supplied to agricultural land has increased considerably since the 1980s. There is the compounding problem of sediment added to rivers and streams due to poor farming practices on erosion prone land. The Manawatu River is a case in point, making it one top six most polluted rivers in New Zealand. Here, however, there is an ambitious plan to address the problem (see Box 6.4).

Box 6.4 Discussion Point: Manawatu River Estuary Management Plan 2007–2012 (Source: Ravine 2007)

The Horizons Regional Council oversees the Manawatu-Wanganui region, which accounts for just over 8% of the country's total land area. Agriculture has been at the core of the region's economy since European settlement. Sixty one percent of the region is pasture and the on the plains and terraces are under intensive primary production pressure. The region has the greatest total area and percentage (61%) of hill country in New Zealand. Most of this is vulnerable to erosion contributing to 11 million tonnes of sediment entering rivers each year. The region has three river systems, the Whanganui, the Manawatu, and the Rangitikei. The Manawatu River is one of the most polluted rivers in New Zealand. Pollution is caused mainly by dairy shed discharges and urban and rural community sewage discharges to the river.

The Horizons Regional Council is developing its second generation planning document in the form of a single plan referred to as 'One Plan'. One Plan aims to integrate the Regional Policy Statement, the Regional Coastal Plan, and five other regional plans that collectively tackle the region's four key issues, poor water quality, increasing demand for water, unsustainable hill country land use and threatened native habitats. Part of this is the 'Manawatu River Estuary Management Plan 2007–2012'. The purpose of this project is to generate a single document under which the Manawatu Estuary is to be managed. As there is currently no single controlling authority, it aims to coordinate responsibilities for management of the Manawatu Estuary among the government agencies, regional and local authorities, private and traditional landowners and public interest groups with an interest in the wetland. The Manawatu estuary is a complex ecosystem comprising many sub-systems. Factors that affect one aspect of its ecology often indirectly affect other aspects. The estuary management plan will consider them all as an interrelated whole.

Critical thinking question: What are drawbacks of the 'One Plan'?

6.5.1 Monitoring the State of Rivers

New Zealand's only national-scale river monitoring programme is the National Rivers Water Quality Network (NRWQN) operated by the National Institute of Water and Atmospheric Research (NIWA). The network samples 77 sites, including 35 major rivers that drain 50% of the country's land area (NIWA 2010). Using this dataset along with water quality measurements from 15 regional councils and unitary authorities, Larned et al. (2004) and Larned et al. (2005) conducted a nationwide assessment of the state of New Zealand's rivers identifying the recent state (1998–2002) and current trends (1996–2002) in water quality in rivers across New Zealand, and to examine spatial patterns in water quality. Assessments were made at the national level and within four land-cover classes (native forest, plantation forest, pastoral, and urban). The results showed that, on average, concentrations of the faecal indicator bacterium *Escherichia coli*, dissolved inorganic nitrogen and dissolved reactive phosphorus exceeded guidelines recommended for the protection of aquatic ecosystems and human health. But water quality varied widely within land-cover classes. *E. coli* and dissolved nitrogen and phosphorus concentrations in the pastoral and urban classes were 2–7 times higher than in the native and plantation forest classes, and typical water clarity in the pastoral and urban classes was 40–70% lower than in the native and plantation forest classes. Water quality was worst in the pastoral urban classes. Assessment of trends in water quality were limited clarity of water and conductivity (indicate of nutrient enrichment) over the period 1996–2002, but the changes were small and the finding inconclusive. The study concluded the following (Larned et al. 2005: 75):

- Rivers with poor water quality are numerous and widespread in New Zealand. Every region of the country has pastoral and urban streams that are currently degraded, or at risk of degradation.
- Poor water quality (defined as inorganic nutrient, *E. coli* and clarity levels that fail to meet recommended guidelines) poses a threat to ecological, recreational and aesthetic values. The effects of nutrient enrichment appear to be most severe in low-land streams within developed catchments where low gradients and absence of riparian canopies can result in heating and reduced aeration.
- Lowland pastoral and urban streams are the most vulnerable to microbiological contamination, due to high livestock densities and high input of contaminated water from outfalls, farm drains, and other point and non-point effluent sources.

Many major rivers in New Zealand rivers are used in one way or another in energy generation, but little national data exists on the environmental impacts of energy use, such as waterways transformed, land areas flooded and sites contaminated from thermal or other pollution.

6.5.2 The Case of the Mighty Waikato

The changing water quality in the Waikato River is significant as it is longest and most used river in New Zealand. It is 425 km long with a catchment area of 1,114,000 ha. A survey of the catchment's status between 1972 and 1978 showed that the river was in bad shape (Ministry for the Environment 1997). Large amounts of fertiliser and approximately 30 billion litres of animal wastes were deposited in the catchment each year. The river also received wastes from 12 dairy factories, two abattoirs, one wool scour, one pulp and paper mill, several open cast coal mines, one sulphur mine, one ironsand mine and 13 urban sewage treatment plants. Further stress came from 13 power stations, nine of which were hydro powered, two thermally powered and two geothermal powered. The stations drew off substantial amounts of cooling water and also discharged effluent into the river. Discharges from a geothermal station were high in toxic elements such as arsenic, fluoride and borate.

In the years since the original survey, the river has been monitored. By 1988 there were significant improvements. However, more recent data show these improvements are confined to only parts of the catchment and that water quality diminishes downstream. The lower reaches of the river drain intensively used farmland and are in far worse condition than the upper reaches of the river. Data collected between 1996–2000 showed that nitrogen levels in the lower reaches of the river (sea-ward of Huntly Bridge) exceed 0.5 g/m^3, the threshold at which the water is considered excessively nutrient enriched (Vant and Smith 2002). This excess of nutrients promotes algal blooms and the growth of plants that choke waterways and displace native species. Similarly, water quality levels of enterococci bacteria (an indicator of health risk) in the lower river have often been recorded at levels that make swimming in it a health risk. Turbidity and faecal bacteria in the lower river commonly exceed the recommended guidelines for recreational waters. Water clarity as measured by visibility distance is less than half a metre in the lower river compared to a visibility depth of 10 m in Lake Taupo, which is the source of the river. There is concern that the growth of dairy farming in the lower catchment may make things worse as more nitrogen fertiliser is used on pasture (Ministry for the Environment 1997).

A study by Scarsbrook (2006) assessed the state and recent trends in river water quality at the national scale for the period 1989–2005. The National River Water Quality Network (NRWQN) is the source of all data examined. The NRWQN includes 77 sites distributed nationally at which river flow is measured continuously and at which 14 physical/chemical parameters are measured monthly. The results showed strong associations between nutrient concentrations and percent pastoral land cover at the national scale. Concentrations of all nutrient species and levels of the faecal indicator bacteria *E. coli* were positively correlated with extent of pastoral land use. Over the period 1989–2005, there are significant increases in oxidised nitrogen (NO_x-N) in rivers that already have high levels of this nutrient.

Scarsbrook (2006) concludes that New Zealand's most nutrient enriched rivers have deteriorated over the period 1980–2005, most likely because of land-use intensification. Levels of dissolved reactive P show a different pattern with concentrations in the most enriched rivers peaking in the late 1990s and showing a decreasing trend since. Detailed trend analysis for the period showed decreasing concentrations of ammoniacal nitrogen and biochemical oxygen demand. Both of these patterns are consistent with improvements in management of point source discharges to waterways (Scarsbrook 2006). With regard to dissolved and total phosphorus and total nitrogen, the results showed upward trends, with positive correlations between the magnitude of the trend and the extent of pastoral land cover in catchments. Overall, the study confirmed the shift from the relative importance of point source to non-point source pollution as key pressure on the nation's rivers. According to the report, water resource management should shift towards a greater emphasis on control of non-point source pollution associated with intensive agriculture.

6.6 Lakes

Water quality of New Zealand's lakes is highly variable, but in general is not well monitored. More than 700 lakes in New Zealand are classified as 'shallow' and up to 40% of these are eutrophic, that is nutrient enriched, and no longer capable of supporting fish life (Ministry of Agriculture and Forestry 1993; Parliamentary Commissioner for the Environment 2005). Most of the badly affected lakes are in the North Island and their contamination is primarily due to increased nutrient loads.

New Zealand's larger, deeper lakes are also at risk and water quality problems in some of these have become quite serious in recent years. For example, in Lake Taupo and the Rotorua Lakes there has been increased growth in certain weeds and nuisance slimes. Lake Brunner is showing signs of increasing nutrient levels and Lake Hayes is affected by phosphorus enrichment. Lowland lakes such as Lake Waipori and Lake Ellesmere Te Waihora have nutrient problems. Nuisance weeds have been found in Lake Dunstan and Lake Wanaka. Less is known about the larger lakes in the South Island than those in the North Island (Ministry for the Environment 2004). Most water quality monitoring focuses on chemical and physical indicators. Ecosystem monitoring is patchy and much of information is held by regional councils, but not in forms that can be easily aggregated nationally (Ministry for the Environment 2007).

Plant growth in New Zealand two biggest lakes, Taupo and Rotorua, tends to be limited by the absence of nitrogen, rather than phosphorus (Parliamentary Commissioner for the Environment 2005). This also applies to the many smaller lakes in the Rotorua District. The amount of nitrogen entering Lake Taupo from rural and urban sources has increased considerably over the past 50 years and monitoring shows that water quality is gradually worsening (Environment Waikato 2005; Rosen 2001) (see Box 6.5). Although the situation in Lake Taupo is not yet serious, regardless of what measures of taken over the short term, with time the situation is likely to get worse rather than better. This is because groundwater is transporting much of the nitrogen from the land to the lake, which is stored underground for several decades before entering the lake (Rosen 2001). In an effort to protect Lake Taupo from further deterioration, a long term strategic plan involving the region's urban and farming communities was launched in 2000, called the 2020 Taupo-Nui-a-Tia Action Plan. The Plan aims to reduce the manageable sources of nitrogen flowing into Lake Taupo from farmland and urban areas by 20% of what they were in 2005 by 2020 (Parliamentary Commissioner for the Environment 2005).

Compared to Lake Taupo, the issue of deteriorating water quality is more serious in the Rotorua lakes, which have been in decline for the past 40 years (see Preface) owing to nutrients from farms and septic tanks that are entering the lakes, reducing dissolved oxygen levels and producing toxic blue-green algal blooms. The lakes suffer the same time delay issues as Lake Taupo, so the situation is expected to worsen. A strategy for protection and restoration of the Rotorua Lakes has been developed by Environment Bay of Plenty, Rotorua District Council and Te Arawa Māori Trust Board, which sets out objectives to reduce nutrient inflow with assistance of both regional and central government funding (Parliamentary Commissioner for the Environment 2005). The strategy emphasises the importance of taking a catchment-scale approach to solving complex river and lake water quality issues.

Box 6.5 Discussion Point: Rural Business: When Farming Becomes a Controlled Activity (Source: Stringleman 2007)

Central and local governments declared in 2007 that they plan to spend $81.5 million on clarifying the waters of Lake Taupo aimed at cutting nitrogen leaching from farming by 20% in 15 years. To date, it was the biggest single environmental expenditure plan in the country. Environmental management has never before been attempted in New Zealand on this scale. Funds are to be spent on small land purchases, covenanting, joint ventures, land swaps, public forestry, recreational development, native forest regeneration, research into low-nitrogen farming practices and upgrading community sewage schemes. The task of spending the money has been entrusted to the Lake Taupo Protection Trust, launched in early February 2007. Environment Waikato will provide 33% of the funding and Taupo council 22%, the rest comes from central government. Local ratepayers will therefore pay three times through their taxes and rates. Because leaching takes decades to reach the lake, nitrogen excreted by animals and farmers long since dead is still degrading water quality. The plan is to make pastoral farming in the lake catchment a controlled activity under the Resource Management Act (RMA). Farmers will then need a resource consent to carry out normal farming practices giving the consenting authority the ability to impose conditions in areas such as nutrient budgeting, fertiliser use, stocking rates, effluent management systems and the use of new technologies like wintering systems and nitrification inhibitors. About 100 farms, covering just 19% of the total catchment area, are being blamed for almost all of the nitrogen leaching. To quickly achieve the targeted 20% reduction in manageable nitrogen reaching the lake, one-fifth of the pasture land needs to be converted to forestry. The Trust might consider the commercial purchase of one-fifth of all 524 km^2 under pasture in the catchment. When it became the legal owner of 13,000–14,000 hectares, the Trust could then re-sell covenanted farms for alternative land uses, most importantly, energy production. An environmental liability (nitrogen leaching) could become a national asset (ethanol).

Critical thinking questions: What arguments justify taking action against farmers today for environmental impacts that have occurred over a long period of time including actions by prior owners of the land?

Among the country's other scenically important lakes, Lake Brunner is showing signs of increasing nutrient levels and Lake Hayes is affected by phosphorus enrichment. Lowland lakes such as Lake Waipori and Lake Ellesmere Te Waihora have nutrient problems. Nuisance weeds have been found in Lake Dunstan and Lake Wanaka. Less is known about the larger lakes in the South Island than those in the North Island (Ministry for the Environment 2004). Most water quality monitoring focuses on chemical and physical indicators. Ecosystem monitoring is patchy and much of information is held by regional councils, but not in forms that can be easily aggregated nationally (Ministry for the Environment 2007).

The NRWQN monitored 35 lakes from 1989 until funding for lake monitoring was cut in 1996 (National Institute of Atmospheric and Water Research 2010). There are 49 lakes that have been monitored for nutrient levels for long enough to identify meaningful trends. Apart from six of these, most show no signs of improvement. Ten lakes show signs of deterioration from already nutrient-enriched (meso-eutrophic) states (Ministry for the Environment 2007). Data from regional councils show that of 134 lakes monitored, 56% are eutrophic (Ministry for the Environment 2006). This means they exhibit signs of nutrient enrichment that promotes frequent algal blooms, including toxic *cyanobacteria* blooms (National Institute of Atmospheric and Water Research 2010).

6.7 Groundwater

Around 50% of community water supplies use groundwater either as a sole or partial source. Interconnections between surface and groundwater mean that contaminated groundwater can spread contaminants (Ministry for the Environment 2004b). There is no national record of incidents or levels of contamination of groundwater aquifers in New Zealand, but nitrogen in the form of nitrate from rural land use is a principal contaminant of New Zealand's groundwater (Davies-Colley et al. 2003). It is noteworthy that 80% of the groundwater bores used for community water supplies are not chlorinated before entering the reticulation system and this includes water serving the regional centres of Napier and Hastings, Lower Hutt and Christchurch (Ministry for the Environment 2004).

Nutrient contamination of groundwater from agricultural land use is quite serious in some regions, especially in areas of processing, intensive horticultural and cropping activity, but data are patchy and regular sampling over long periods has not occurred. The data that are available on nitrate contamination suggest it is a problem in all regions of the country, and that nitrate "hotspots" will increase in the future (Close et al. 2001; Ministry for the Environment 2004). About 39% of over 1,000 monitored groundwaters in New Zealand have nitrate concentrations that are above natural background levels. Close to 5% have nitrate concentrations that make the water unsafe to drink and 104 sites have levels of bacteria that make general consumption unsafe (Ministry for the Environment 2007).

Environment Canterbury (2002) conducted a review in 2002 of nitrate concentrations in Canterbury groundwater. Almost 7% of the samples collected had nitrate-nitrogen concentrations higher than the maximum accepted value of 11.3 mg/L. There are growing concerns over the suitability of Canterbury plains groundwater as a continued source of drinking water, because of a predicted increase in nitrate concentrations due to new irrigation schemes and more intensive land use. A recent report states that groundwater in the Ashburton-Rakaia area of the Canterbury

Plains, widely used for private drinking water supplies, is now no longer suitable for human consumption in some parts without treatment (Hayward and Hanson 2004).

Many geothermal water phenomena (geysers, hot springs, mud pools) have been affected by human activities. As of 1997, there were no geothermal fields that were formally protected from draw off (abstraction). Between 1950 and 1990 the number of active geysers declined from 130 to 11 as a result of flooding for hydro dam construction, the draw-off of steam for geothermally-powered electricity production and the draw-off of hot water for household and commercial use (Ministry for the Environment 1997).

6.8 Drinking Water

Most of the drinking water systems that serve 85% of the country's population are considered safe, while a further 2% (serving 5% of the population) are only marginally safe (Ministry for the Environment 1997). According to a drinking-water survey in 2003, water supplies provided to 71% of New Zealanders complied with bacteriological standards (Ministry of Health 2005). This represents a 2% improvement since 2002. The percentage of the population using public water supply that complies with national drinking water guidelines rose from 50% in 1994 to 83% in 2004 (OECD 2007). But 15% of the population is supplied drinking water that does not meet national drinking water guidelines. Most (71%) of the water supplies (serving 8% of the population) have not been graded because they are in small communities of less than 500 people. Approximately 15% of the population are not connected to community supplies (Ministry for the Environment 1997). About 80% of the population are served by public waste water treatment (OECD 2007).

6.9 Conclusion

This chapter has shown that New Zealand's management of freshwater is far from exemplary. Often sources of pollution appear individually small but are cumulatively significant. The main pressures on freshwater flows have been from drainage and channelisation, which have reduced wetlands and altered the natural character of rivers; deforestation, which has increased flooding and sedimentation in steep catchments and increasing demand for agricultural and municipal water supplies. The main sources of pressure on water quality are from runoff of animal wastes from pastures, fertiliser and sediments as well as runoff of pollutants from paved surfaces in urban areas, and point source discharges such as from industrial plants factories and sewage outfalls. Responses to these problems have focused successfully on improving point source discharges, such as from sewage, factory and dairy shed outfalls.

New Zealand's environmental information on freshwater needs considerable upgrading if the state of the nation's environment is to be reliably assessed and trends detected. While it has demonstrated that some very good data and analyses of it do exist, the chapter has shown that it is too limited spatially, temporally and by topic to reliably capture national trends. To ensure that the desired results of environmental management are achieved, the quality, quantity of information on the terrestrial environment needs to be improved.

Study Guide

End of Chapter Summary

6.1 Water management is based on minimization of risk of supply and maximisation of water quality. In environmental management, the focus is usually on the latter. A range options are available to water managers faced with changing circumstances. One widely used classification distinguishes between 'supply-side' and 'demand-side' options. Another approach distinguishes between technological, behavioural, economic, and legal measures to manage freshwater.

6.2 The country's water resource base is large. People have had a significant impact on New Zealand's water flows and water quality. The greatest impacts, however, have not come from water use, but from land use. The moist serious impacts are from agricultural land use.

6.3 Management of freshwater, including groundwater and geothermal water, is the responsibility of the country's 17 regional authorities the boundaries of which are demarcated by watersheds. Stakeholders in the industrial sector, as well as central and local governments, accept that much remains to be done to reduce further damage to the country's freshwater and to repair damage that has already occurred. Consequently, there have been numerous attempts to address this, but so far, real progress has been slow.

6.4 The use of nitrogen fertiliser in New Zealand has climbed rapidly. Once nitrogen is leached to the environment there is no effective way to remove it.

6.5 The main environmental pressures on the flow of freshwater in New Zealand have been from: (a) drainage and channelisation, which have reduced wetlands and altered the natural character of rivers including lowland aquatic habitats; (b) deforestation, which has intensified flooding and sedimentation in steep catchments; and (c) increasing demand for urban water supplies, livestock and irrigation.

6.6 More than 700 lakes in New Zealand are classified as 'shallow' and up to 40% of these are that is nutrient enriched and no longer capable of supporting fish life. Most of the badly affected lakes are in the North Island. New Zealand's larger, deeper lakes are also at risk and water quality problems in some of these have become quite serious in recent years.

6.7 Nutrient contamination of groundwater from agricultural land use is quite serious in some regions, especially in areas of processing, intensive horticultural and cropping activity but data are patchy and regular sampling over long periods has not occurred. The main sources of pressure on water quality are from runoff of animal wastes from pastures, fertiliser and sediments as well as runoff of pollutants from paved surfaces in urban areas, and point source discharges such as from industrial plants factories and sewage outfalls.

Discussion Questions

Why are riparian zones so important?
What is polluted water?
What are the major causes of water pollution in New Zealand?
Why are lakes more susceptible to pollution than rivers?
Why is ground water so susceptible to pollution? What are the major sources of groundwater pollution in New Zealand?
Explain why water pollution in New Zealand is a growing problem.
Distinguish between point-source and non-localised sources of water pollution.
Give examples of how sediment from erosion can be a pollutant.
What is the meaning of eutrophic? What are its environmental consequences?

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Chapter 7
Ocean and Coast

Key Questions

- What is the nature of New Zealand's coastline, marine environment and marine species?
- Which coastal waters are most affected by human activities?
- What is the Quota Management System and how does it manage commercial fishing?
- What is bottom trawling and what are its environmental impacts?
- Why does sustainable fishing in New Zealand require more than just sustaining the yield from a particular target fish stocks?
- What is set out in the Fisheries Act 1996 and why is it significant?
- Should and can New Zealand control the introduction of exotic organisms into its coastal waters?
- How well protected are coastal ecosystems?
- What is the Oceans Policy?

Abstract The ocean and coastal environments are a fundamental part of the New Zealand way of life. Most of the population live within easy travel distance to the coast and for many people the ocean plays a large part in recreational activities, including family holidays, swimming, surfing, fishing or boating. The ocean holds particular spiritual and cultural values of importance to Māori and is considered an important food source. Many of the traditional Māori practices connected with the sea still exist and as well Māori have an ownership interest in a large share of the commercial fishing industry. Concerns over the environmental effects of fishing and waste disposal in coastal waters have increased in recent years. Considerable gaps exist in the ability to monitor changes in the marine environment identifying a weakness in any claims to be an environmentally responsible nation. The need for an ocean policy framework has long been recognised but has still to be realised.

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Key Concepts and Terms Bottom trawling • By-catch • Continental shelf • Customary fisheries management • Estuaries • Exclusive economic zone • Fish Monetary Stock • Fish stock • Fisheries Act 1996 • Marine invasive species • Marine Reserves Act 1971 • *Mataitai* reserves • Native marine biodiversity • Oceans Policy • Ocean zones • Quota Management System • Seamount • Sustainable fishing • *Taiapure*

7.1 Physical Setting

New Zealand is responsible for an ocean area of over four million square kilometres (Fig. 7.1). It is the fourth largest marine environment in the world. Only the United States, Indonesia, and French Polynesia have larger maritime areas. It includes approximately 800 underwater mountains, some of which are higher than Aoraki (Mt Cook). The Kemadec Trench extends for about 1,200 km. New Zealand's ocean boundaries encompass four so-called 'zones': (i) continental shelf, (ii) exclusive economic zone (EEZ), (iii) contiguous zone, and (iv) internal waters and territorial sea.

The continental shelf zone covers an area of 24 million hectares, which is only slightly smaller than New Zealand's total land area of 27 million hectares. The zone is spatially defined by the co-ordinates of its continental shelf (or margin) where these are known; otherwise the outer boundary is taken to be 200 nautical miles from the coast. Within this zone, New Zealand has sovereign rights over the management of the resources of the seabed but not the water column. These rights include construction of artificial islands and drilling on the continental shelf.

The EEZ covers an area within 200 nautical miles from coast. Within this area New Zealand has absolute rights and obligations over the management of the resources of the seabed and water column, marine scientific research and protection and preservation of the marine environment. The contiguous zone encompasses an area within 24 nautical miles from the country's coasts. The New Zealand Government and its agencies have jurisdiction in this zone to prevent or punish infringement of customs, fiscal, immigration or sanitary laws. The internal waters and territorial sea are defined by boundaries that run 12 nautical miles from coast. These are considered part and parcel of the territory of New Zealand and come under the jurisdiction of the Resource Management Act (RMA).

New Zealand has 15,000 km of coastline, the eighth longest of any nation. About two-thirds of the coastline is hard, rocky shore while sand or gravel shores account for about one third. Some 80% of the coast is directly exposed to the sea, the remainder is sheltered in harbours and estuaries. Much of the coastline is made up of river-fed estuaries, the wide shallow waters of which are protected from ocean waves by sand or shingle bars or offshore islands. Sandflats and wetlands associated with shallow estuaries are usually the most productive ecosystems on Earth and New Zealand is no exception to this. In New Zealand, some estuarine ecosystems are based on plants, such as the mangrove tree (*Avicennia marina resinifera*), which

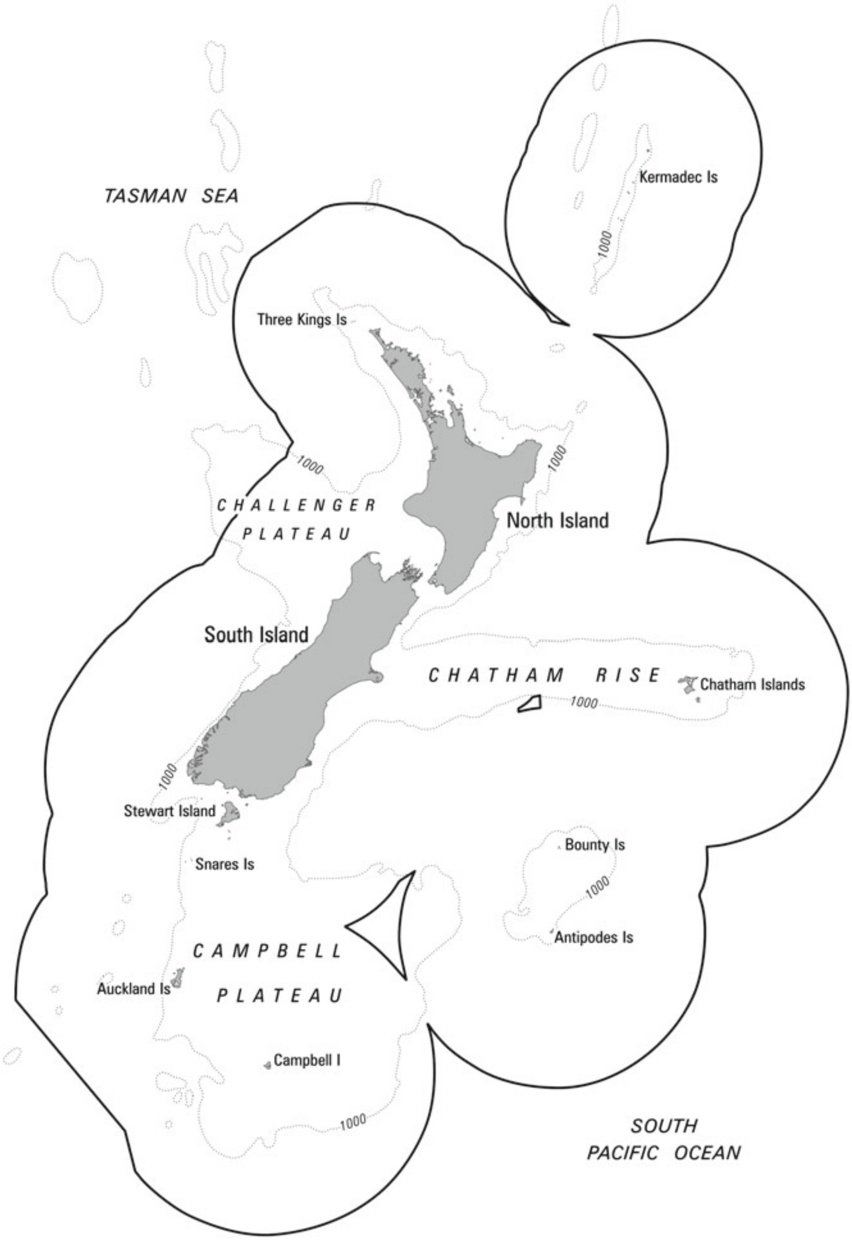

Fig. 7.1 Ocean boundaries of New Zealand's Exclusive Economic Zone

flourishes in the warm harbour and estuarine waters of the northern third of the North Island. The mangrove ecosystem is low in species diversity, but is a habitat for 30 or so fish species.

Over two thirds of New Zealand's marine environment is under the ocean surface at more than 1,000 m deep. Much of this area is unexplored, but estimates from surveys indicate a seascape comprising numerous large plains, deep trenches and seamounts that result in a great variety of marine habitats. Seamounts are underwater mountains over 1,000 m in height. They are ecologically significant features high in endemic species and providing rich habitats that serve as stepping stones for the dispersal or migration of species across wide oceanic areas (Gianni 2004). According to the Ministry of Fisheries (2006), over 15,000 marine species have already been found living in seas around New Zealand and it is thought that another 50,000 may yet be found here. This could represent about 10% of the world's known marine species. Also, the country's isolation in the south-west Pacific means that there are many species unique to New Zealand. Many migratory species also visit New Zealand waters, and some marine mammal and seabird species depend on New Zealand breeding areas and feeding grounds for their existence. Almost half the world's cetacean varieties (whales, porpoises and dolphins) have been observed in New Zealand's waters. New Zealand's ocean environments also support the greatest number and variety of seabirds in the world. Some are transient, while others live and breed around New Zealand. The marine environment is also home to a large number of different species of fish, shellfish, squid, crabs, lobster, sponges, starfish, sea eggs and seaweeds.

From a commercial fishing perspective, the immense size of New Zealand's EEZ is misleading as two thirds is of no commercial fishing value owing to extreme depths and the lack of nutrient-rich currents (Ministry for the Environment 1997). In 2004, fish products became New Zealand's sixth largest export earner; however, New Zealand's total fish catch annually is only 1% of the global total (OECD 2007).

7.2 Coastal Waters

The quality of New Zealand's coastal marine waters is, on the whole, high by international standards. There are some exceptions and the impacts of a deteriorating coastal environment are diverse and sundry. Increasing development along the coastline (such as marinas and housing) and the loss of stabilising dunegrass or seagrass beds due to deteriorating water quality will impact on the quality of the coastal environment and increase coastal erosion and sand loss. This threatens coastal habitats and incurs high costs associated with rehabilitation. Coastal development involving reclamation of important coastal wetlands and swamps and the clearance of native vegetation destroy entire communities of flora and fauna. Unhealthy marine, estuarine and coastal environments could affect tourism. If the water is not safe to swim in, or the beach has been washed away, the human experience of natural amenity assets is compromised.

The harbours, bays, estuaries and coastal waters around the country receive the outflow of hundreds of rivers, the stormwater run-off from many towns and cities, and sewage from both rivers and coastal outfalls. Serious incidents are not

Box 7.1 Case Study: Bay of Islands Sewage Incident (Source: Far North District Council 2006)

In the far north region of the North Island, about 30 oyster farms were closed during an event in 2006 because of faecal contamination in oyster flesh. This was the fourth break in the local sewerage system between the Waitangi Major pumping station and the Paihia wastewater treatment plant since 2001. The cause was a structural failure of a pipeline linking the pumping station and the treatment plant that was fixed after having been undetected for about 48 h. The pipe was within its design life but an alarm had failed to be triggered when leaking commenced. An estimated 2,250 m^3 of raw sewage discharged onto land about 1 km from the Waitangi River. It flowed over farmland and through a natural reed bed and wetlands before reaching the river. Because of this natural treatment process and the distance from the river, the impact on waterways was minimised. As a precaution and on the advice of Northland Health, the Far North District Council erected signs warning against swimming at each end of the Waitangi-Haruru Falls walkway and at Haruru Falls. Northland Health required the closure of commercial oyster farms at Orongo Bay and advised that people should not gather shellfish from the Waitangi estuary kaimoana beds for 28 days. Swimming bans applied in the Bay of Islands. Northland Health re-opened the Orongo Bay commercial oyster farms 5 days after they were closed. The kaimoana oyster beds remained closed for several days longer as a precautionary measure pending tests to be carried out.

Critical thinking question: Why is eating shell fish in particular a problem following exposure to sewage outflows?

uncommon (Box 7.1). The quality of coastal water is monitored by regional councils, but such measurement is usually confined to bathing and shellfish gathering areas and, typically, the results show that New Zealand's coastal water quality is high (Ministry for the Environment 1997). Generally, coastal waters have fewer bacteria than river sites, except in the vicinity of large coastal cities, especially Auckland. Harbours on these cities also collect spillage and effluent from vessels.

In is not uncommon for Auckland City's heavily used east coast beaches to be unsuitable for bathing for several days each year. The problem is especially bad for beaches where storm water drains receive inflows of sewage during heavy rainfall events. On many city beaches, stormwater pipes emerge at the top of the beach disgorge their content across the full width of the beach that in summer months might be used by several hundreds of recreationists every day. With a few exceptions, coastal water near river mouths, in some harbours and estuaries, and near outfall pipes is unsuitable for shellfish gathering. Occasionally there have been blooms of sea lettuce in some city harbours such as Tauranga, which has been attributable to increased nutrient inputs (Ministry for the Environment 1997; Hawes 1994). The outbreak of toxic algal blooms may also be nutrient related (Box 7.2).

Box 7.2 Case Study: The Toxic Algae Threat (Source: Ministry for the Environment 1997)

A small number of algal species produce powerful hepatotoxins or neurotoxins that can be transferred through the food chain where they may harm or kill other life forms such as zooplankton, shellfish, fish, marine birds and mammals and humans that feed, either directly or indirectly, on them. High density algal populations that contain toxins are referred to as harmful algal blooms (HABs). They contain billions of marine algae that are normally invisible to the naked eye, but become visible as red, brown and green patches in the sea when populations explode to densities of more than 100,000/L. Very little is known about HABs. A HAB outbreak of a dinoflagellate called *Gymnodinium breve* in Northland during the summer of 1992/1993 produced a substance called brevetoxin which causes Neurotoxic Shellfish Poisoning (NSP). Symptoms in humans include respiratory problems, diarrhoea, muscular weakness and changes in skin sensitivity in which hot water feels cold and cold water seems hot. The toxin enters the food chain when algae are ingested by filter-feeding shellfish such as mussels, oysters, scallops and clams and by algal grazers such as paua. Humans became infected by eating the shellfish or simply by inhaling sea spray which contained broken cells of *Gymnodinium breve*. Since this HAB crisis, many theories have been put forward to explain the event. Some thought nutrient pollution was the cause while others blamed ballast water discharged from foreign ships; especially since, prior to the crisis in 1992 the toxic dinoflagellate algae were not known in New Zealand waters. Alternatively the algae may have been dormant in small numbers with their sudden blooming caused by the weather conditions linked to an El Niño event. To reduce the risk of future outbreaks, shellfish and phytoplankton are now monitored at several places around the New Zealand coastline.

Critical thinking question: What are the various hypotheses on the causes of toxic algal blooms? What conditions favour their occurrence?

7.2.1 Estuaries

The coastal waters that are most affected by human activities are the estuaries. Most estuaries have people living on or near them and six have cities with populations of over 100,000 people. Estuaries have also been affected by the management of surrounding land and tributary rivers; for example, where river water has been diverted for irrigation or other reasons, the estuary's water changes from freshwater to brackish or saline. No recent assessment of the nation's estuaries has been undertaken since 1976, but a Ministry for the Environment report (Ministry for the Environment 1997) states point source discharges have been considerably improved in many areas and measures have been taken to restore water quality in many harbours, such as Whangarei. The results of assessments of estuarine contamination in the Auckland region reported by the Ministry for the Environment (1997) found that, although there has been a steady fall in contamination from pesticide residues, such as DDT and chlordane, there has been a steady increase in concentrations of heavy metals (specifically lead, zinc and copper) and hydrocarbons (specifically polycyclic aromatic hydrocarbons, or PAHs). About half of Auckland's 3,500 ha of coastal sediment were found have "excessive concentrations of lead, zinc and copper, with circumstantial evidence of reduced animal diversity, elevated contaminant levels in shellfish and crustaceans, and changes in their growth or behaviour" (Ministry for the Environment 1997: 7.74). The worst affected areas were estuaries and upper, sheltered parts of harbours (Auckland Regional Council 1995, 2005). The main sources of contaminants are road motor vehicles and roofs. The heavy metals come from tyres (zinc), galvanised iron roofs (zinc) and vehicle wiring (copper). PAHs come from vehicle exhausts through binding with dust and soil particles which are then washed into the stormwater system. PAHs levels were not measured in concentrations that would threaten aquatic life but any contamination is a concern as it can accumulate over time. The former Auckland Regional Council (1995) estimated that if the then current rates of contamination continue the proportion of contaminated estuarine sediment will expand from 50% to 70% by the year 2021.

7.2.2 Waste

Urban development results in an increase in impervious surface area such as roofs, roads, paved areas, a change in vegetation cover and soil compaction. This reduces rainfall infiltration and increases run-off. Urban pollutants accumulate in run-off and are carried to estuaries and harbours. Of most concern to urban water managers are heavy metal concentrations (zinc, copper, lead) in runoff and their toxic effect on aquatic life. The former Auckland Regional Council (2004a, b, c, 2005) reported that zinc concentrations in the Auckland harbour have exceeded thresholds of ecological health guidelines for the 20 years prior to 2005 and have predicted further increase. Studies show that 56% of coastal environments receiving urban runoff have either degraded health (25%) or are unhealthy (31%) and a general increase in the ecological impact is predicted (Auckland Regional Council 2004a, d).

Monitoring of contamination of shellfish commenced for the Auckland region in 1987 starting with the Manukau Harbour, and from 1999 included the Waitemata Harbour and Tamaki Estuary. Copper levels in shellfish were reported as 'relatively high' compared to international standards and zinc levels within 'typical' range (Auckland Regional Council 2004c). However, unambiguous historical trends could not be identified due to strong inter-annual variability.

Waste disposal from boats is a problem in some gulfs and bays in New Zealand. It has been estimated that about 45% of the total fish catch by commercial fishers is outside their quota or not of interest for processing and classed as waste material, much of which is thrown overboard (Ministry for the Environment 1997). The decomposing waste could deplete oxygen levels (Livingston and Rutherford 1988) and enough waste could arrive at the sea floor to alter the species composition (Grange 1993). Oil and diesel spill are also a problem in the busy harbours and bays, but data are incomplete. Non-biodegradable litter, such a plastic bags and containers, aluminium cans, glass bottles and nylon nets and rope, is a widespread problem, especially near urban areas (Ministry for the Environment 1997; Gregory 1991). Plastic items are by far the most common. The build up of long-lived litter on the ocean bed can interfere with the exchange processes between sediment and water kill organisms essential to the habitats there (Goldberg 1995). Also, plastic items and nylon nets are thought to be a greater cause of death of marine mammals and birds by swallowing and entanglement than oil or other toxic materials.

A study of Auckland's stormwater outlets found that over 10 million items per year, mostly plastic, are discharged into the Waitemata Harbour (Island Care New Zealand Trust 1995). However, it is believed that New Zealand's marine debris contains less plastic and fewer bottles compared with many other countries. National data on the environmental impacts of transport on runoff are virtually non-existent. Local studies of the impacts on coastal storm water outflows have been conducted in Auckland and some other cities.

7.2.3 Sedimentation

The effects of soil erosion from farmland and land clearance are twofold: a valuable resource is lost from the farm and the downstream effect of eroded sediment entering waterways is enormous. Sediment contamination in waterways does a great deal of damage. Average sedimentation rates in estuaries are typically at least 10 times higher than they were before Europeans arrived in New Zealand (Ministry for the Environment 2007). The environmental effects include (Parliamentary Commissioner for the Environment 2005; Davies-Colley et al. 2003; Ministry for the Environment 2007):

- degradation of substrates for bottom-dwelling organisms
- reduced food quality for bottom-dwelling organisms (in streams)
- clogging of fish spawning gravels
- smothering of estuarine animals
- shoaling of estuaries
- infilling of lakes and reservoirs
- siltation of water supply intakes

The disappearance of some seagrasses in harbours and estuaries has also been attributed to increased turbidity of sea water caused by sedimentation (Turner 1995). The Ministry for the Environment (1997) has reported on the work of Hume and McGlone (1986) that claims deforestation by early Māori communities led to a three- or four-fold increase in estuarine sedimentation in some areas. The past century has seen this trend continue, with sediment accumulating at a rate of 3–6 mm/year in sandy estuaries and 2–5 mm/year in muddy ones (Burns et al. 1990). Recovery from the impacts can take many years, with some being more or less irreversible as in the case of estuary shoaling or lake infilling (Davies-Colley et al. 2003). The particular case of mangroves in estuaries is revealing (Box 7.3).

Box 7.3 Discussion Point: Spread of Mangroves (Source: McShane 2005)

The mangrove trees of New Zealand (*Avicennia resinifera*) grow only in the top half of the North Island of New Zealand and are found in harbours and estuaries around the coast. Control of mangroves can be a source of controversy. To some it is an eyesore and a cause of waterways becoming silted as the mangrove prevents complete tidal flushing. Conservationists and some tangata whenua say that mangroves provide a unique habitat essential for marine and bird life.

Regional council options range from a “do nothing” approach to permitting the removal of mangroves where they are deemed to be a nuisance. The action taken depends partly on the explanation for the expansion of mangroves. One theory is that rapid expansion of mangroves since the 1960s is the result of increased sediment flows, caused mainly by clearing of vegetation, expanding residential development and runoff from farm land, made worse by nutrient run off from farms and orchards. This is challenged by evidence of the spread of mangroves where sediment run-off is being reduced by planting and by improved stormwater and wastewater management. This suggests that the main cause of the mangrove boom is more likely to be removal of cattle and sheep from the edges of harbours, tidal rivers and estuaries that would otherwise eat young mangroves.

Originally livestock freely grazed coastal pasture. Since the 1960s, farmers who used to be quite relaxed about letting their cattle feed on mangrove beds began to feel social and legal pressure to prevent their cattle having access to the water’s edge. Current programmes to protect waterways may be generating a greater need to manage mangroves in those same waterways. Otherwise estuarine habitats risk being lost to mangroves as massive reclamations of water to land occur as mangroves die and their beds turn into dry land. While reducing nutrient flows may slow mangrove growth, the removal of cattle, sheep and other predators means that mangroves will continue their current explosive expansion, unless something replaces the impact of browsing livestock.

Critical thinking question: How would you adjudicate between the interests of those wanting to control the spread of mangrove and those wanting nature to take its course?

7.2.4 Coastal Erosion

All coastal areas are affected by erosion to some degree as part of normal beach and coast behaviour. However, human impact can be a factor, especially on sandy coasts. Beaches are dynamic systems affected by four main processes: supply of sand or sediment to a beach; wave energy; sea-level change; and location of the shoreline. Extracting sand on or near the shore can upset the balance of erosion and accumulation. Damming rivers and taking water for irrigation changes the flow condition in the rivers and thus supplies of sand to the coast. Construction of ports or harbours that project offshore alter the patterns of sediment transport along the coast.

There are four approaches to managing shoreline erosion: hard stabilisation, soft stabilisation, relocation, or do nothing. Hard stabilisation involves using fixed hard structures, such as walls perpendicular to the shoreline (groynes) or sea walls parallel to the shore to hold the shoreline in place. Such installations are expensive and can disrupt the flow of sand along the shore and lead to the loss of sand elsewhere along the coasts. They also restrict beach access and are often considered by some to be unsightly. Hard stabilisation is very seldom removed, it is simply made bigger. But hard structures often cause erosion on adjacent beaches leading to even more hard structures.

Soft stabilisation, or ‘beach nourishment’, involves bringing in sand from another area. This option is costly and the solution only temporary. Relocation or retreat from the coast can be difficult politically as well as costly if government is required to compensate landowners. The ‘do nothing’ option comes from lessons learned elsewhere that suggest for some coastal situations: (i) there is no medium term solution, or (ii) no action is justified. In the first case, the rationalisation is that if started intervention will need to continue to remain effective as there are no one-off response that can be relied on to provide a permanent solution. In the second case, inaction can reflect a judgement that the loss of coastal land causes no serious problem perhaps because buildings can be relocated when threatened by erosion.

7.2.5 Coastal Management and Legislation

Management of coastal water is the responsibility of local government (regional councils) which, under the Resource Management Act, are required to “safeguard the life-supporting capacity of waters and ecosystems and ensure that water users avoid, remedy, or mitigate any adverse effects of their use on the environment” (Ministry for the Environment 1997: 7.8). Local authority approval is required for discharging pollutants into coastal waters or placing structures on the coast. The Resource Management Act requires the preparation of a coastal policy statement with the Department of Conservation responsible for its preparation.

A new New Zealand Coastal Policy Statement (NZCPS) formally took effect in December 2010, which replaces the NZCPS 1994. The purpose of the NZCPS is to articulate policies relevant to Resource Management Act 1991 that established a coastal management regime based on a partnership between the New Zealand Government and the community through regional and local authorities. The Resource Management Act requires a NZCPS to guide local authorities in day to day management of the coastal environment, as well as provide a guide for planning documents and a reference for the Environment Court when considering resource consent applications. The NZCPC 2010 differs from the 1994 document in that there are new policy topics and changes of emphasis that introduce new priorities for coastal management. But most of the content of the NZCPC has yet to be interpreted through application of the Resource Management Act process and its successful translation into management actions is highly dependent on outcomes of the Resource Management Act process.

The new policy makes significant demands of local governments to identify and protect the natural character of coastal environments within their jurisdiction, but NZCPS policies are not binding rules; they are simply considered alongside other matters when reaching decisions on resource consent applications. The NZCPS applies to the coastal environment defined as an area extending from 12 nautical miles offshore to the 'inland limit'. The latter is not defined in law and will vary from region to region depending on local geography. The NZCPS 2010 provides more explicit and specific direction to local governments councils on strategic planning than the NZCPS 1994. An example of this is in planning for the needs of ports, including their integration with the regional transport system. Another is to give both marine farmers and communities more certainty about where aquaculture will and will not be suitable. The statement also gives stronger direction to councils on management of coastal water quality, which is critically important for aquaculture. The aim is to ensure better environmental outcomes as related to the protection of outstanding natural landscapes, protection of native biodiversity and habitats, control of discharges, improvement of water quality, and environmental monitoring.

A weakness of the NZCPS 2010 is that it attempts to direct how coastal hazards are to be managed by focusing on the hypothetical impacts of sea level rise from 'global warming'. This can be viewed as simplifying how any change in climate might affect the coast. The coastal zone is a high energy environment subject to known variability in storms, tsunami and other natural events that affect coastal erosion, inundation and risk to the wellbeing of coastal communities. On the other hand, whereas the NZCPS 1994 is weak on environmental monitoring, under the NZCPS 2010 local authorities will need to improve their monitoring performance in the coastal environment, both in terms of what is monitored and in how much detail, to enable transparent assessment of the effectiveness of management decisions.

The NZCPS 2010 also acknowledges other legislation which involves the coastal environment, such as that affecting fisheries, aquaculture, marine reserves, reserves, the conservation estate, walking access and particular areas such as the Hauraki Gulf, Fiordland and the Waitakere Ranges. Coastal ecosystems are under-represented in protected areas in New Zealand. Active protection applies to just a few percent of the coastal waters within 1 km of the three main islands. As discussed further below, protected marine areas can act as both reservoirs of biodiversity and nurseries for some commercial fisheries. The number of marine reserves has increased significantly in the past two decades and there has been progress in other areas too. The Fisheries Act (see Sect. 7.3.2) requires that measures be taken to reduce by catch of marine mammals, birds and marine invertebrates such as corals. However, serious problems from bottom trawling and incidental capture and mortalities remain. Wider protection of marine ecosystems needs to be addressed.

Beyond the 12 nautical mile limit of the territorial sea, where the Resource Management Act does not apply, there is a lack of consistency in provisions for control of environmental or other impacts in the form of principles such as those underpinning the Resource Management Act, especially with regard to commercial fishing and dumping. A re-think of this will be part of the development of the Oceans Policy (see Sect. 7.7) and possibly the formation of a dedicated central agency for managing ocean territory and resources.

There are two international agreements on marine pollution that are important to the coastal environment: the London Convention 1972, which sets minimum standards for the dumping and incineration of wastes at sea, and the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL) which, together with the 1978 MARPOL Protocol, specifies controls on the discharge of oil and oily mixtures, noxious liquid substances, sewage and garbage. For these conventions to be ratified, they must be incorporated into New Zealand law. Only the London Convention has been ratified. Rules to ratify MARPOL are still being developed. Amendments to the Resource Management Act have strengthened existing controls on pollution from ships and offshore installations; however, the situation is far from perfect as the October 2011 grounding of the container ship Rena off Tauranga harbour illustrated. The tardy response to contain leaking oil and prevent widespread oil contamination of the coastline is evidence of lack of preparedness to manage such events.

7.3 Fisheries

Fish stocks are populations of a particular species of fish, for which natural growth and death rates are considered to be known. Each population is treated as a unit for the purposes of fisheries management. There are about 1,000 recorded fish species in New Zealand waters, but of these only about 40 species are commercially important. The popularity of the various species changes over time. For example, in the 1960s and 1970s most of the fish landed were from just 10 species, the main ones being snapper, tarakihi and trevally. The number of species now caught is wider than those first targeted. The majority of stocks are now fully exploited. The main changes in the last 20 or so years have centred on: deepwater species such as hoki, orange roughy and southern blue whiting; surface feeding (pelagic) species like tuna, mackerels and kahawai; and shellfish such as paua, rock lobster and squid; and aquaculture (mussels, oysters and salmon).

Fish exports in 1975 were 14,000 tonne, but were up to 129,000 tonnes 6 years later. Soon a situation arose where there were too many boats chasing too few fish

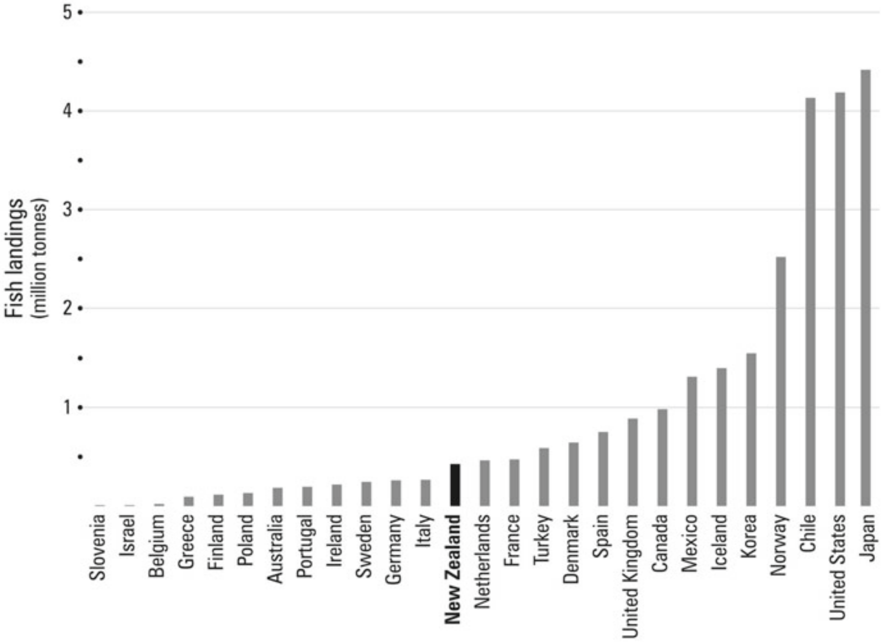

Fig. 7.2 Fish landings (×10^3 tonnes) in domestic and foreign ports in 2007. Source: OECD (2010)

and coastal fisheries began to show signs of collapse. The government intervened. From 1980 a freeze was placed on permits for fin fish. Two developments grew from this crisis that transformed the New Zealand fishing industry: a move into deep-sea fisheries and a new fisheries management system.

Management of New Zealand's fisheries has increased but it remains incomplete. Fisheries management can now draw on a range of laws and regulations including: the Fisheries Act 1996; Quota Management System; Quota Management Areas; Stock Management Units; restricted areas; closed seamounts; fishing gear restrictions; compulsory by-catch reporting, implementation of the National Seabird Plan of Action, Wildlife Act 1953, Marine Mammal Protection Act 1978, and defined sub-areas. Management has not prevented over-fishing and serious depletion of some individual fish stocks, but the current regime gives more potential to intervene once there is evidence of fish stocks or fishing grounds coming under pressure. From the mid-1960s to the mid-1970s, there was increasing growth in fish exports. Bigger well equipped boats replaced smaller, traditional vessels, and large onshore fish-processing plants were built. Annual total fish catch rose rapidly prior to the late 1980s, but levelled out after that. Compared with other OECD countries, New Zealand's fish catch is relatively small. For example, in 2007, New Zealand had the 15th highest fish landings out of 27 OECD countries that had data available, which is just a fraction of the total annual catch of the major fishing nations (Fig. 7.2).

7.3.1 The Quota Management System and the Fisheries Act 1996

New Zealand's first fisheries legislation was applied to oyster fisheries in 1866. Protection for finned fish, such as closed seasons and limits on the mesh size of nets, came into being with the Fish Protection Act 1877. These measures were eventually combined under the Fisheries Act 1908. The plan was to manage fish and shellfish stocks for future catches. If a fish species was in demand but stocks were dwindling, legislation could help ensure its catch was reduced until stocks recovered. This was essentially the philosophy of fisheries management until 1983. New Zealand was credited with introducing the most advanced fisheries quota system in the world (Pearse and Walters 1992). That regime was facilitated by the Fisheries Act 1983. When the Act was amended in 1996 it became the first piece of New Zealand legislation to include the precautionary principle (Wheen 2002). Despite this, there is evidence that fisheries have been depleted partly because the quota system has failed to give quota holders a sufficient incentive to conserve stocks (Bathgate and Memon 2000).

Enhanced economic efficiency over other fishery regimes is claimed for the individual transferable quota system (Tietenberg 1992). In theory, transferability of quota enables the most efficient operators to accumulate quota from less efficient operators. Alongside the setting of a total allowable catch, this should encourage conservation of fish stocks given that quota holders gain an incentive to protect the long term value of their quota. This ideal outcome relies on the accurate setting of the total allowable catch, acceptance of that limit and the removal of any motivation to exceed the quota limit in order to maintain a minimum short term return on the quota investment. New Zealand is no exception in failing to reach these ideal requirements for a quota management system (QMS) (see Bathgate and Memon 2000; Young 2004).

The background to and nature of the QMS as an environmental policy tool was discussed in Chap. 3, but some further aspects are worth noting in the context of an evaluation of the New Zealand marine environment. The QMS was introduced in 1986 with the aim of preserving commercial fish stock, giving security to fishing companies and providing a basis for companies to manage their investment in plant and equipment. The QMS allows the New Zealand government to put specific fish stock under quota management. The Fisheries Act 1996 and its subsequent amendments reinforce the QMS and improve the processes for identifying and introducing fish stocks into the QMS and revising the commercial fishing permit regime. This controls fisheries activity by setting a total allowable catch (encompassing commercial, recreational and customary Māori fishing) from which an annual total allowable commercial catch is set. As well, the Minister is empowered to set restrictions over the fishing methods, timing of activity and precise areas fished. When a species is first taken into quota, those rights are allocated according to the historic participation in the fishery at no cost to those receiving quota. Purchasing or leasing individual transferable quotas is then allowed. The quotas are expressed as a proportion of the total allowable commercial catch, allowing automatic adjustment to the annual catch limit. This is a change from how the scheme was first introduced. Initially, tradable units were set as tonnes of fish per year rather than as a share of the total allowable catch. This resulted in the government facing a $100 million bill to buy back units when it was realised that too many units had been allocated (Kerr et al. 2003). Over 30 of the commercially most important fish species are now controlled through the quota system.

The QMS assumes that fisheries are a renewable resource that can be harvested sustainably. This requires an understanding of how fishing affects marine ecosystems. New Zealand's fisheries management has been struggling to build this understanding with even the methods used for obtaining research data being a point of contention between industry participants. The aim is to maintain the fish stocks at or near the levels that can produce the maximum sustainable yield (MSY), a concept that was introduced in Chap. 1. The difficulty is that it is impossible to accurately model fish stocks and replenishment rates, as marine ecosystems are not in a steady state of equilibrium and fish populations tend to intermingle whereas MSY is easier to apply to single species management.

In 1994, the official assessment was that only 4 of 30 quota species were being fished at sustainable levels (cited in Le Heron 1996). Bathgate and Memon (2000) suggest that overfishing of quota limits, misrepresenting catch data, catching fish for which quota is not held and overfishing of the more accessible fishing grounds are known problems. Underlying this unsustainable behaviour has been a tendency for fishers to reject scientific assessments that report a need for reducing quota volumes. Environmental groups have also voiced concern that it is acceptable for the Minister to set the total allowable commercial catch at a level that maintains fishing within the maximum sustainable yield over a 10 year period rather than restricting catches to within the sustainable yield each fishing season (Wheen 2002).

7.3.2 Aquaculture

New Zealand aquaculture production has risen considerably over the past 20 years and the sector now employs about 30% of the total seafood industry workforce (Ministry of Fisheries 2011). Aquaculture is the farming of fish, shellfish or aquatic plants, in natural salt-water or freshwater environments or controlled conditions. Fish are grown in sea cages or on-shore freshwater hatcheries, pens or tanks. Shellfish are cultivated using either suspended long-line rope structures, trays in the tidal zone or baskets and on-shore tanks. Greenlipped mussels (*Perna canaliculus*), also known as Greenshell Mussel or Green Mussel, currently dominate New Zealand's aquaculture industry, followed by Pacific King Salmon (*Oncorhynchus tshawytscha*) and Pacific oysters. Paua (abalone) farming is a small but growing business. New Zealand's clean coastal waters, a large coastline with many sheltered bays and an abundance of plankton are ideal conditions for shellfish aquaculture. The Marlborough Sounds is the country's most important mussel and salmon farming area. Other significant farming areas are in Golden Bay and around the Coromandel peninsular and Stewart Island and for Northland for oyster.

Greenlipped mussels are New Zealand's largest seafood export. They are native to New Zealand and while they grow wild, it is the farmed mussel that supplies the commercial domestic and international markets. The government sets no limit on the volume of mussels grown commercially. Typically, a mussel farm consists of a series of lines attached to buoys anchored to the seafloor at each end. The mussels are grown on strings of weighed ropes that hang down from these lines. The most common environmental effects of mussel and oyster farming are localised changes to the seabed and water column through the deposition of organic and shell material from farms and the depletion of plankton by the shellfish. The effects of depend on farm management practices and the farm's location and site characteristics, such water depth, currents, exposure and seabed habitat type (Grange 2002; Keeley et al. 2009).

Pacific King Salmon were introduced to New Zealand in the 1800s, with the intention of establishing a wild commercial fishery, but this was unsuccessful. Salmon farming was seen as an alternative and by the 1960s salmon farms were well established in the Marlborough Sounds, on the East Coast of the South Island and Stewart Island. The salmon are reared from eggs in freshwater hatcheries then grown to adulthood in saltwater pens either in river mouths or coastal bays. The major markets for salmon are Japan, Australia and the United States. Common environmental effects of salmon farming are localised changes through the deposition of faeces and uneaten feed. As with shellfish farming, the magnitude and extent of effects depends on the site conditions and farm management practices (Forrest et al. 2007).

The regulations governing aquaculture in New Zealand are comparatively recent, the most recent reforms of which came into effect in October 2011. The new legislation took the form of amendments to a variety of laws embodied in the Resource Management Act (1991), Aquaculture Reform (Repeals and Transitional Provisions) Act 2004, Fisheries Act 1996, Māori Commercial Aquaculture Claims Settlement Act 2004, the Tasman Regional Coastal Plan, and the Waikato Regional Coastal Plan (Ministry of Fisheries 2011). The changes included: removing the requirement for aquaculture management areas to be established before consent applications through the Resource Management Act (RMA) can be made; allowing applications to be made to farm a wider range of species, including finfish; establishing the Coromandel Marine Farming Zone; streamlining the undue adverse effects (UEA) fishing test, better integrate the UAE test with consent processes, and balance the interests of commercial quota holders with those of aquaculture; and establishing new legislation to enable the Treaty of Waitangi settlements to be delivered to Māori on a regional basis, through agreements between the Crown and iwi. The overarching process by which marine and freshwater farms are established and managed is through the RMA. A prospective farmer must provide a thorough and independent scientific investigation of the potential ecological effects of the planned farm.

7.4 State of the Fisheries

Fish Monetary Stock measures the asset value of New Zealand's commercial fisheries, but it excludes aquaculture, recreational and customary catch, and commercial species not currently managed by the QMS. Fish monetary stock accounts released by Statistics New Zealand in February 2010 showed that their value had risen from a financial value of $3.97 billion to $4.017 billion in the year to September 2009, which was an increase of 47% since 1996, when they were valued at $2.7 billion. Careful management of these resources is vital as potential impacts on the marine environment from fishing are enormous. They include direct harvesting pressure as well as indirect pressures from trawling and dumping of offal on nursery ecosystems (e.g. coral communities, seamounts, bryozoan mats).

In 1997 there were 42 fish species and 185 fish stocks in the QMS; 10 years later it covered 96 fish species and 619 fish stocks in the QMS. By this time 15% of fish stocks (by weight) were listed as having been over-fished (Ministry of Fisheries 2008). Species with 13 stocks listed as overfished in 2007 include gemfish, grey mullet, hoki, orange roughy, paua, rig, snapper, southern blue whiting and southern bluefin tuna. By 2009, there was information to report on the status of 117 stocks or sub-stocks out of a total of 628 stocks managed under the QMS (Ministry of Fisheries 2009). Of these 117 stocks, 79 were considered near-to-above target levels as specified in the Fisheries Act. At that time, 38 stocks were considered to be below target levels, including stocks of two tuna species, orange roughy stocks, black cardinal fish, gemfish, two rock lobster stocks, Tasman Bay and Golden Bay scallops, three paua stocks, west coast North Island snapper, all bluenose stocks and longfin eels. Allowable catch levels have been reduced in all these fisheries to allow them to rebuild to acceptable target levels (Ministry of Fisheries 2009).

It is noteworthy that around a third of the total fish catch (by weight) comes from stocks that have not been assessed scientifically (Ministry of Fisheries 2008). Reasons for the shortfall given by the former Ministry refer to the difficulty and expense of conducting full assessments on all stocks. Fisheries officials prioritise the assessment of the most valuable and the vulnerable stocks on a yearly basis.

Benthic Protection Areas (BPAs) have been identified within the EEZ. In 2007 the New Zealand government instituted 17 Benthic Protection Areas (BPAs), which are closed to bottom trawling and dredging. BPAs are areas considered to be representative of the different marine habitats in the EEZ. In 2007 BPAs covered 32% of the country's EEZ, which includes 28% of Underwater Topographic Features (including seamounts), 52% of seamounts and 88% of active hydrothermal vents (Ministry of Fisheries 2008). BPAs cover 1.1 million square kilometres of seabed is considered to be the largest single marine protection initiative in any nation's EEZ (Ministry of Fisheries 2008).

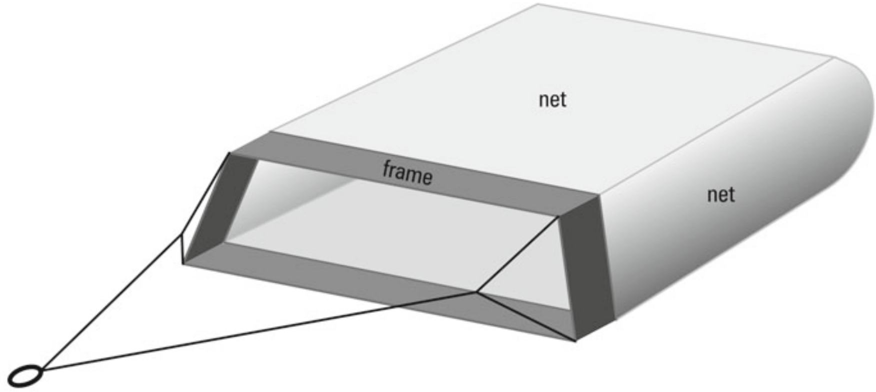

Fig. 7.3 Box dredging net. Use of a box dredge in fishing involves towing a steel net (dredge) 2–4m across the opening along the sea floor, usually in water 10–100 m deep. Dredging can be particularly destructive as it physically scours the sea bed. Source: Ministry of Fisheries (2006)

7.4.1 Classifications of Marine Environments

There are two ecological classifications for New Zealand's marine environments, which are used together for state of the environment reporting (Ministry for the Environment 2007). The Coastal Biogeographic Regions Classification (CBRC) applies to waters less than 200 m deep along the coast. New Zealand is divided into 13 CBRCs classified according to known ecological patterns and the physical characteristics. The Marine Environment Classification (MEC) is used as a framework for marine environments in waters deeper than 200 m. The MEC is a tool for depicting areas of similarity in the marine environment based on eight physical characteristics: depth, sea-surface temperature, seabed slope, tidal current and annual solar radiation. It was developed in 2005 by NIWA with support from the Ministry for the Environment, Department of Conservation and Ministry of Fisheries. There are two levels of spatial resolution within the MEC: a broad scale classification of the whole entire EEZ at a spatial resolution of 1 km; and the finer scale classification of the Hauraki Gulf region at a spatial resolution of 200 m. Ultimately, it may provide a spatial framework for compiling inventories of marine resources and perhaps for developing policies for management of protection of the marine environment. The MEC is available on line at www.koordinates.com. It contains the data and documentation needed to use in a Geographic Information System.

7.4.2 Bottom Trawling and Dredging

Bottom trawling and dredging are two fishing methods commonly used that severely damage the seafloor and the seafloor animal communities, especially on seamounts. In New Zealand, most of the dredges are inshore and aimed at shell fish, particularly scallop fishing to about 50 m depth. Box dredges are commonly used (Fig. 7.3). These usually have tines on the leading edge to dig into the benthic layer and scoop up the shell fish. The bottom trawl nets are larger and can go down to 1,500 m or deeper. They have a breadth that can be over 100 m wide and are heavier. They have heavy hawsers and bobbins and doors that damage the seafloor. These practices can be especially destructive as they physically scour the sea bed (National Academy of Sciences 2002). Damage due to by-catch of non-target species (1,000 marine mammals and many non-target fish per year) can be serious. Efforts have been made to reduce by-catch by using exclusion devices on nets to prevent sea lions from getting caught, but their success rate is not good in terms of letting animals live.

Wild oysters are collected by dredging, with the main commercial fishery operating in Foveaux Strait. Here dredging has removed bryozoan reef communities as well as exposed some marine life previously sheltered by the reef to storm and tidal action. Bryozoan reefs are an important habitat for a variety of species diversity, including oysters and other commercial species such as blue cod. A disease (*Bonamia*) has repeatedly infected oysters in the Foveaux Strait fishery already stressed by heavy harvesting (Box 7.4) causing large-scale mortality. This is likely to have been worsened by the impacts of dredging as it modifies the seabed in a way that stresses the oysters. In areas where dredging has stopped, seafloor habitats have started to regenerate and oyster numbers have increased (Cranfield et al. 1999).

Box 7.4 Case Study: Seafood Icon (Source: Ministry of Fisheries 2006)

The Foveaux Strait dredge oyster (also known as the Bluff oyster) has been fished commercially in Foveaux Strait for over a 100 years. In the mid-1980s, the Ministry of Fisheries began to tackle the issue of *Bonamia exitiosus*. This parasite was killing oysters and caused the fishery to close midway through the 1986 fishing season. Fishing began again the next year, but the oyster beds most affected by *Bonamia* stayed closed in case fishing worsened the problem. However, the Ministry found *Bonamia* spread anyway. They tried to limit the spread of infection by selectively dredging the central part of Foveaux Strait. This too failed, and the infection continued to spread. The fishery was closed completely in 1993 for 3 years. By 1996, the population had recovered sufficiently for the fishery to be reopened and in 1997 the oyster fishery was added to the Quota Management System. The infection ran its course by the end of 1990s, but reappeared in 2000. Oysters in the Foveaux Strait are fished over the 6-month season from 1 March–31 August; however, the start has been delayed in recent years to allow the population to rebuild. A better understanding of the environmental impact of using dredges in Foveaux Strait is required. The Ministry of Fisheries aims to develop a fisheries plan for the Foveaux Strait oyster fishery. The plan's development involves commercial, recreational and customary fishing representatives, scientists who have worked for years on oysters, environmental groups, fishery officers, and managers.

Critical thinking question: How might excessive harvesting of the Bluff oyster be linked to slow recovery (or failure to recover) following *Bonamia exitiosus* parasite infestations.

7.4.3 Health of Fish Stock

Determining the state of a fish population is difficult as the database is not as good as it might be. Considerable data have been collected on marine fish and invertebrates, but analysis has largely been confined to the commercially important target species. Catch data are the main monitoring method. The status of marine ecosystems and non-target species is unknown. There not enough data to reliably assess the effects of bottom-trawling on the ecosystems of seamounts. Setting quotas for individual species is problematic as methods for estimating maximum sustainable yield are inexact making calculations of quotas not always reliable. This is particularly true with deep-sea stocks. In the early 2000s, the Ministry of Fisheries had records on the status of 60–70% of stocks. Of these, about 80% were thought to be at or near target levels for sustainable harvest. The remaining 20% of fish species are in decline or remained depleted.

Hoki is one of New Zealand's biggest fish exports. Although hoki grow reasonably quickly, they do not reach mature spawning age until they are 4–5 years old. The signs of over-fishing were first apparent during the mid-late 1990s when fewer young hoki were produced. This meant a lot fewer adult fish were available, so catch levels had to be reduced quite severely (Ministry of Fisheries 2006). The 2005 stock assessment indicated the western fish stock was below the government's target level (Ministry of Fisheries 2006). To let the stock rebuild, the government has been progressively reducing catch limits from 250,000 tonne in 2000/2001 to 100,000 tonne in 2005/2006. Other issues of concern are the deaths of seabirds and seals, and the impacts of bottom trawling in the hoki fishery. The fishing industry is working on ways to keep albatrosses and petrels away from the sterns of trawlers where their trawl warps enter the water. A code of practice to avoid seal captures is in place in the hoki fisheries, but capture rates are variable (Ministry of Fisheries 2008).

Orange roughy is also a valuable commercial species. Like hoki it is caught by bottom trawling in deep waters and like hoki these fish are slow-growing and long-lived. An orange roughy may live over 150 years and does not breed until it is 20–30 years old. The Ministry of Fisheries openly admits that it is not easy to manage orange roughy fisheries sustainably and mistakes have been made (Ministry of Fisheries 2006). Because these fish live in such deep water, they are difficult and expensive to research. From the 1970s, the total catch of orange roughy in New Zealand waters peaked at 54,000 tonne in 1989. Initially, it was thought orange roughy would have similar breeding and growth rates and breeding success as other commercial species elsewhere in the world. By the late 1980s, research had shown this was not the case. This came too late to save the Challenger fishery (Golden Bay, Tasman Bay, Marlborough Sounds, and northern part of West Coast), which has been effectively closed since 2000 (Ministry of Fisheries 2006). Now New Zealand's main orange roughy fisheries are on the Chatham Rise (the biggest orange roughy fishery in the world) and off the southeast North Island/

northern South Island. The orange roughy stock on the northeast Chatham Rise appears to be above management targets (Ministry of Fisheries 2006). Of New Zealand's 11 orange roughy stocks, scientists think six are probably near or above the government's target level, while three stocks are below (Ministry of Fisheries 2006).

Snapper is often referred to as New Zealand's most important finfish species. Commercial fishers catch snapper using a range of methods including longline, trawl, Danish seine, beach seine and set nets. Snapper was over-fished in many places around New Zealand in the 1960s and 1970s. Commercial catches peaked in 1978, at 18,000 tonne and restoration of snapper stocks has been slow, with several still below the government's target level in the mid 2000s (Ministry of Fisheries 2006). As a result, a variety of management measures have been put in place: catch limits, size limits, gear restrictions, and fishing area closures. As well, minimum size limits and daily catch limits have been imposed for recreational fishers. Additional measures include bans on trawling and Danish seining in certain bays and harbours to protect young snapper and reduce conflict between commercial and non-commercial fishers. Other marine species are under stress, which includes Red Rock Lobster (*Jasus edwardsii*) and Paua (Blackfoot paua–*Haliotis iris*). Aware that the wild fishery is a diminishing resource globally, the New Zealand government announced in September 2007 a cut in the hoki catch from just over 100,000–90,000 tonne, half that recommended by fishery companies. At the same time it declared reductions to orange roughy and red cod quota in fisheries around the coast.

7.4.4 Challenges to Sustainable Fishing

The Fisheries Act 1996 recognises that environmental sustainability requires more than just sustaining the yield from particular target stocks. It also requires the protection of marine ecosystems to maintain habitat biodiversity. There is the additional objective of preserving of some marine ecological areas through marine reserves and parks (through the Marine Reserves Act), as both reservoirs of biodiversity and nurseries for some commercial fisheries. Similarly the New Zealand government has developed a strategy aimed at improving the protection of high seas biodiversity and addressing the threat to seamounts and other vulnerable underwater structures from particularly damaging bottom-trawling. The strategy reflects New Zealand concerns about the environmental impact of bottom-trawling.

Another major challenge facing the industry is to reduce the impact on untargeted species. Efforts have been made to reduce by-catch by using exclusion devices on squid-fishing nets to prevent sea lions from getting caught. There are methods to discourage albatrosses and other seabirds from taking longline hooks. And technology has allowed more accurate targeting of fish schools to ensure that fewer non-commercial fish varieties are caught in nets. Recent laws have closed parts of the North Island's west coast to set netting, in places where the endangered Maui's dolphin is found. In the past, government officials have indicated that they do not have enough information to know to what extent trawling affects the ecosystems of the 800–900 seamounts in the New Zealand region (Clark and O'Driscoll 2003).

One of the most important issues in fisheries at present is the theft and illegal sale of paua. Exact quantities stolen are not known but some estimates suggest that nearly as much paua may be stolen each year as is harvested commercially. Industry and government are working together on ways to reduce this theft. The sensitivity of paua to damage from being removed from their anchor point aggravates the problem. This is a problem where fishers damage a paua when taking it, then find out it is too small and have to put it back. To manage fishing's 'footprint' on other species, and on marine habitats and ecosystems, limits must be set around what level of effect is acceptable, and what is not. In 2005, the Ministry of Fisheries set out a Strategy for Managing the Environmental Effects of Fishing (SMEEF), which describes how such limits will be set. Three key factors are to be considered when setting environmental limits: weighing up whether effects on species or habitats are sustainable in the long-term; what society feels is the right balance between use and protection; and what the needs of future generations might be.

The ability to do this in practice is limited by the budget allocated to fisheries research. The complexity of the aquatic environment has also to be considered. Each year research is undertaken for only a small proportion of the 592 stocks within quota management areas. The aquatic environment is a vast area with thousands of species. Information on the size of the population of a particular fish species in a specific area is not sufficient to effectively manage and thus ensure the wellbeing of the ecosystem. Greater use of risk assessment techniques as part of its management approach is occurring but such techniques do not eliminate the potential for fish stocks to be reduced to sub-optimal levels.

New Zealand's QMS is no different from other systems internationally in that fisheries management has not been primarily concerned with managing fish ecosystems or the marine environment. Rather, it is focussed on decisions surrounding how people may best exploit marine resources and deciding what best use of these resources is or should be. There is heavy reliance on MSY, which was developed for single species management, rather than for integrated ecosystems management. Understanding fish stocks and their sustainable limits requires knowledge of fish habits, rates of reproduction, rates of growth, behaviour, range of tolerances, food supply and natural cycles in the size of fish populations. There is an over-reliance on modelling fish stocks and "best estimates" that are simplified formulations that do not reliably mimic the real world. They only represent what the modeller believes are the most important or basic functions for a particular species of fish.

7.5 Māori

The oceans hold particular importance to Māori. The sea has spiritual and cultural values and historically it was an important food source to the tribes who lived near the coast. Giving seafood or *kaimoana* was a way of showing hospitality and generosity at *hui* (meetings) and *tangi* (funerals) and other gatherings. Today Māori are still very closely involved with the marine environment and many of the traditional Māori practices centred on the sea and coast have survived into modern times. As discussed in Chap. 2, Māori have had to seek redress to protect their customary and commercial interests as in the action they were required to make before the passing of the 1992 Treaty of Waitangi (Fisheries Claim) Settlement Act. This allocated to Māori approximately one-third of the commercial fishing quota as well as an entitlement to 20% of the quota for any species subsequently included in the national management regime (Bess 2001; James 1996).

Customary fisheries management arrangements such as *mataitai* reserves or *taiapure* are both available under the Fisheries Act. 1996: *Taiapure* are local fisheries in coastal waters which recognise the special significance of the area to local iwi or hapu, either as a source of seafood, or for spiritual or cultural reasons. *Taiapure* give Māori greater say in the management of their traditionally important areas. A major difference between *mataitai* and *taiapure* is that *taiapure* allow commercial fishing. A *taiapure* proposal from a local community must go through a public consultation process before it is approved. Once set up, a committee nominated by the local Māori community advises the Minister of Fisheries on regulations to control all types of fishing within the local area. In 2005, Māori owned about 40% of the commercial fishing quota, in addition to their non-commercial customary fishing rights. Tangata Kaitiaki (guardians) manage customary fishing in accordance with regulations: 125 kaitiaki in the South Island, 146 in the North Island. However, these rights and others have had a chequered history.

In 2004 legislation was passed that had the effect of the restricting the ability of Māori to convert customary rights into customary titles over the foreshore and seabed. It followed a Court of Appeal decision earlier in 2004 that raised the possibility that Māori could obtain title to the foreshore and seabed (see Box 7.5). Concern that the Appeal decision would ultimately result in private ownership of more of New Zealand's coastline and restrict the government's ability to profit from offshore mineral extraction, the government passed the New Zealand Foreshore and Seabed Act 2004. Subsequently, the Marine and Coastal Area Act 2011 retracted the Foreshore and Seabed Act 2004 and amended a range of legislation including the Crown Minerals Act 1991, the Resource Management Act 1991, and the Conservation Act 1987. A key facet in the Marine and Coastal Area Act is that it restored customary rights to the "common marine and coastal area" (CMCA), which encompasses all of the marine and coastal area which is not a national park conservation land, a reserve, or privately held. The New Act has guarantees of public access to the CMCA, including the right to engage in recreational activities on the CMCA and also guarantees the continued fishing rights both private and commercial, such as quota allocated under the Fisheries Act 1996.

Box 7.5 Discussion Point: Foreshore and Seabed (Source: Committee on the Elimination of Racial Discrimination, 66th Session 17 February–11 March 2005, Decision 1 (66): New Zealand CERD/C/DEC/NZL/1)

In 2004, a Court of Appeal decision raised the possibility that Māori could obtain title to the foreshore and seabed. This arose following the effort of a tribal group Ngati Apa to assert that their customary use of a part of the Marlborough foreshore should be reflected in them gaining legal title. This was consistent with the Treaty of Waitangi but it conflicted with the expectation that foreshore and seabed were public domain, protected by the crown for the enjoyment of all New Zealanders.

Concern that the Appeal decision would ultimately result in private ownership of more of New Zealand's coastline and restrict the government's ability to profit from offshore mineral extraction, the government passed the New Zealand Foreshore and Seabed Act 2004. This legislation had the effect of restricting the ability of Māori to convert customary rights into customary titles over the foreshore and seabed. It remained possible for Māori to establish ancestral connection to the foreshore and seabed but this could lead only to the recognition of customary rights, title will remain with the Crown.

United Nations Committee on the Elimination of Racial Discrimination visited New Zealand in 2005 and reported on the new legislation. It noted the scale of opposition to the legislation among Māori and their very strong perception that the legislation discriminates against them. The Committee concluded that, on balance, the legislation contained 'discriminatory aspects against the Māori, in particular in its extinguishment of the possibility of establishing Māori customary titles over the foreshore and seabed and its failure to provide a guaranteed right of redress'. Subsequently, and for reasons other than this judgement, the Act was replaced by the Marine and Coastal Areas Act that relaxed some of the impediments in the way of establishing customary title over coastal land.

Critical thinking question: Does the seabed and foreshore issue illustrate the unwillingness of New Zealanders to trust the environmental responsibility of Māori?

7.6 Oceans Policy

The lack of strong ocean policy has long been a fundamental weakness of New Zealand's marine environmental policy. In the early 2000s, the New Zealand government decided to develop a new oceans policy both to protect the ocean environment and develop economic opportunities (Ministry for the Environment 2005). It aimed to deal with all aspects of oceans management and, in particular, deal conflicting idea on such things as marine farming, marina development. Development of the policy took place in three stages. Stage One was creation of a vision for an oceans policy. Stage Two aimed to design policies based on public consultation to achieve the vision defined from Stage One and Stage Three to deliver policies, processes and tools identified in Stage Two as necessary to achieve the vision. Stage One was completed in 2001, but it was not until 2005 that New Zealand government approved a shortened vision statement for the new policy work as: ‘Healthy Oceans: wisely managed for the greatest benefit of all New Zealanders, now and in the future’.

Since the development of a national oceans policy began in 2000, it has faced a number of challenges that have stalled its progress, most notably the dispute between Māori and the New Zealand Government over title ownership of coastal land and water. According to Vince and Haward (2009), the development of fisheries and oceans policies has demonstrated the complex nature of interactions between the fishing industry, Māori and the New Zealand government. While the use market-based instruments remain the dominant approach in the management of New Zealand’s ocean and marine resources, there has been a shift towards community and cooperative forms of governance, which Vince and Haward (2009) believe will become more prevalent. This policy development is likely to occur in the areas of aquaculture, seabed exploration and Māori involvement in fisheries and oceans management.

7.7 Marine Invasive Species

New Zealand’s coastal ecosystems have evolved in isolation, cut off by deep ocean basins and currents. Some coastal organisms that can overcome these barriers unassisted are found naturally all over the Southern Hemisphere. Other species are unable to move over long distances or would not survive a long passage away from their home environment. This allowed distinctive marine ecosystems to survive. Contact through international trade changed this and growth of this trade means that New Zealand’s coastal ecosystems are increasingly exposed to flora and fauna from the world at large. By 1998 around 127 species of introduced marine organisms had become established. By 2002, 16 had become serious and expensive pests (Troup 2004). Among the marine invasive species well established in New Zealand are several types of seaweed and other algae, crabs, barnacles and other crustaceans, coral-like bryozoans, tube worms sea squirts, and oysters, mussels and other molluscs. There has been minimal action in response to invasive marine species although they threaten native marine biodiversity (Craig et al. 2000).

The Biosecurity Act 1993 gave the Ministry of Fisheries the power to control the introduction of exotic organisms into New Zealand’s coastal waters, but several other government agencies are involved in the prevention, detection and management of marine invasive species (Wotton and Hewitt 2004). In 2004 some biosecurity responsibilities were taken over by the Ministry of Agriculture and Forestry’s new authority, Biosecurity New Zealand. The Ministry for the Environment, the Department of Conservation, the Ministry of Health, the Environmental Protection Authority (formerly the Environmental Risk Management Authority) and regional councils are also involved in developing policy guidelines, enforcing legislation (such as the discharge of ballast water), and monitoring, controlling or eradicating marine pests.

Marine invasive species can have a variety of harmful effects. Many invasive species are more aggressive or competitive than native species, which they displace. They may cause changes to important features of the habitat and to the functioning of an ecosystem as a whole. Some invasive species grow so prolifically that they clog up or foul surfaces. These so-called fouling species block shallow waterways and important utilities such as water intakes and outlets. A tubeworm (*Ficopomatus enigmaticus*), which causes major fouling in brackish waters, was found in the Whāngārei harbour region in 1967. Like the *Watersipora arcuata* calcareous growths formed thick encrustations on the hulls of boats and wharf piles. *Ciona intestinalis*, a sea squirt from the North Atlantic arrived in Lyttelton harbour in 1940, and in 2005, *Styela clava*, a sea squirt from Korea, was discovered in the Waitamata and Lyttelton Harbours (Troup 2004). The sea squirt is an immobile filter feeder that attaches itself to the sea bottom or other underwater surfaces. It is a major nuisance to mussel farms.

Laminarian kelp (*Undaria pinnatifida*), first found in New Zealand in 1987, grows about 1 centimetre a day to a size of 3 m. It stifles native seaweeds and is a threat to the habitat of pāua (*Haliotis iris*). Invasive toxic microalgae or phytoplankton give rise to blooms and can cause illness in humans, either directly or indirectly through shellfish that is eaten, and can also affect aquaculture operations. Three species of estuarine cordgrass were introduced intentionally from Britain early in the twentieth century. It was not long before cordgrass began choking estuaries, fundamentally changing estuarine ecosystems, affecting wading birds, and the spawning and feeding opportunities for fish. It also intensifies flooding and will encroach on beaches.

The Pacific rock oyster (*Crassostrea gigas*), which became established in the early 1970s, has brought benefits as well as costs. Because it is Faster growing than the native New Zealand rock oyster (*Saccostrea glomerata*), it out competed quickly became dominant and is now harvested commercially. A small Asian mussel (*Musculista senhousia*) was found in New Zealand in the late 1970s and soon appeared in such densities as to exclude native shellfish such as pipi and cockles. However, their patchy colonies often collapse after a few years, so their effect is temporary (Troup 2004).

The Ministry of Fisheries has named six potential super pests, which would be far more destructive than those already established. This is because they have had a severe impact on environments similar to New Zealand's. They are Asian clam (*Potamocorbula amurensis*), Chinese mitten crab (*Eriocheir sinensis*), European shore or green crab (*Carcinus maenas*), Mediterranean fanworm (*Sabella spallanzanii*), Northern Pacific sea star (*Asterias amurensis*), and seaweed caulerpa (*Caulerpa taxifolia*) (Troup 2004).

7.8 Marine Reserves

Protection of New Zealand coastal marine reserves is mostly administered by the Department of Conservation under the Marine Reserves Act 1971. The Act allows areas of territorial sea (up to 12 nautical miles off-shore) to be set aside for scientific study where they “contain underwater scenery, natural features or marine life of such distinctive quality, or so typical, or beautiful, or unique, that their continued preservation is in the national interest”. Recreational fishing and mineral exploration may be permitted in a marine reserve. Illegal activities include discharges of any sort, commercial fishing, sand extraction, public works, interference with marine life and shooting. In addition, the protected area provisions of the Wildlife Act and the Reserves Act have been used to create protected areas in the tidal zone of estuaries (Ministry for the Environment 1997). Regional councils use regulatory measures, such as Estuarine Protection Zones, to control damaging activities in coastal waters and on their margins (Ministry for the Environment 1997).

Initially the Marine Reserves Act of 1971 was interpreted as having a research rather than a conservation purpose. New Zealand’s first marine reserve of 5.17 km^2 opened in 1977. It was an area around Goat Island adjacent to the University of Auckland Goat Island Marine Laboratory at Leigh north of Auckland off the coast near Warkworth. In the 19 years to 1989 only two marine reserves where neither commercial nor recreational fishers can operate, with a combined area of less than 3,000 ha had been created. Since 1990 several new marine reserves were established under the Marine Reserves Act. The most notable of these is the 748,000 ha of the entire area of the Kermadec Islands north of the North Island of New Zealand. Three more reserves were established in 2005 (Whangarei Harbour, 231 ha; Volkner Rocks in the Bay of Plenty, 1,290 ha; and Parininihi in North Taranaki, 1,759 ha). In December 2006 the 840 ha Kupe/Kevin Smith Marine Reserve off Wellington’s south coast was set up. By 2011 there were 33 marine reserves that took the area protected to about 8% of New Zealand’s territorial sea. However, most of this is in two marine reserves around isolated offshore island groups (Auckland and Kermadec) and very little in the territorial sea of the North Island and South Islands of New Zealand. Of New Zealand’s total marine environment, less than 0.6% is protected in marine reserves. The highest level off protection outside of New Zealand’s territorial sea is through fisheries closures on trawling for 36 seamounts, discussed earlier.

The Department of Conservation monitors marine reserves to assess any changes that may occur and better understand marine ecosystems. New Zealand aims to establish a network of Marine Protected Areas to protect a full range of marine habitats and ecosystems to effectively conserve marine biodiversity. The New Zealand Biodiversity Strategy (Department of Conservation 2000) goal includes having 10% of the marine environment in a network of Marine Protected Areas by 2010. To achieve this, a Marine Protected Areas Policy is being developed.

Mataitai reserves are created in areas of traditional importance to Māori for food gathering. Tangata whenua are authorised by the Minister of Fisheries to manage and control the non-commercial harvest of seafood from the reserves through a local community committees. A *tangata tiaki/kaitiaki* can recommend bylaws to manage customary food gathering in keeping with local sustainable management practices, and issue customary food authorisations. *Mataitai* reserves are permanent, but bylaws can change. Commercial fishing is not allowed mataitai reserves unless recommended by the *tangata tiaki/kaitiak*i. However, non-Māori may fish in *mataitai* reserves.

7.9 Conclusion

There is an adage in environmental management circles that says: you cannot manage it unless you understand it and can measure it. As far as fisheries ocean management is concerned, ecosystem understanding of environmental issues is poor and data on it are inadequate. Thus, an ecosystem approach to fisheries management is not possible at present. New environmentalism must contend with the promotion of environmental agendas that can be based on selective concerns rather than an ecosystem understanding of environmental issues. There are many good examples of this in fisheries and ocean management in New Zealand and globally.

Approximately half of the area within New Zealand's ocean boundary lies at depths below 2,000 m. But little is known of the fauna, ecosystem functioning at this depth, or how the habitats there and their biodiversity are linked to more productive surface waters. In light of this it is difficult to manage productive surface waters regionally without an understanding of ecosystems links that exist with abyssal habitats. Thus, new environmentalism must recognise that it is currently near impossible to identify threats and impacts to biodiversity and ecosystem functioning beyond natural environmental variation.

The first priority in ocean management in New Zealand and elsewhere is to develop an ecosystem-scale understanding of biodiversity in the marine environment. This involves undertaking research to describe and characterise the diversity, distribution and quantity of fauna and flora. The second priority is to determine the role of different organisms in marine ecosystem function. Both are necessary to develop an understanding of what is important to preserve to ensure sustainable use of marine resources.

Poor water quality from wastewater, stormwater and industrial discharges, inappropriately managed aquaculture activities, recreational and commercial fishing activities and introduced species can have negative impact on marine ecosystems and reduce marine biodiversity. Unhealthy marine and estuarine environments or overexploitation will result in reduced fish stocks.

This chapter highlights the fact that New Zealand's environmental information Management Action needs considerable upgrading if the state of the nation's marine environment is to be reliably assessed and trends detected. While it has demonstrated that some good data and analyses of it do exist, the chapter has shown that it is limited spatially, temporally and by topic to reliably capture national trends other than in a few areas. To ensure that the desired results of environmental management are achieved, the quality, quantity of information on the ocean and coastal environments needs to be improved.

Study Guide

End of Chapter Summary

7.1 New Zealand's ocean boundaries encompass four zones: continental shelf, exclusive economic zone, contiguous zone, and internal waters and territorial sea. The country has 15,000 km of coastline, the eighth longest of any nation. Over two thirds of country's marine environment is under the ocean surface at more than 1,000 m deep.

7.2 The coastal waters that are most affected by human activities are the estuaries. The Resource Management Act is a key instrument for managing the coastal maritime environment within the 12 nautical mile limit of the territorial sea. Beyond this, there is a lack of consistency in provisions for control of environmental or other impacts, especially with regard to commercial fishing and dumping.

7.3 The Fisheries Act 1996 and Quota Management System are used to control commercial fishing. The system enables fishing companies can plan ahead, based on their guaranteed share of the catch. The system is designed to give an incentive for fishing companies to sustainably harvest their catch.

7.4 About a third of the total fish catch (by weight) comes from stocks that have not been assessed scientifically. About 15% of fish stocks are listed as having been overfished. Bottom trawling and dredging are two fishing methods commonly used that severely damage the seafloor and the seafloor animal communities and species, especially on seamounts.

7.5 Māori are closely involved with the marine environment. The 1992 Treaty of Waitangi (Fisheries Claim) Settlement Act allocated to Māori approximately one-third of the commercial fishing quota as well as an entitlement to 20% of the quota for any species subsequently included in the national management regime. Consequently, Māori are also involved with some of New Zealand's largest fishing businesses.

7.6 Since development of a national oceans policy began in 2000, it has faced a number of challenges that have stalled its progress, most notably the dispute between Māori and the New Zealand Government over title ownership of coastal land and water.

7.7 A large numbers of invasive marine species are well established in New Zealand, but action in response has been minimal. The Biosecurity Act 1993 gave government agencies the power to control the introduction of exotic organisms into New Zealand's coastal waters.

7.8 Protection of New Zealand coastal reserves is mostly administered by the Department of Conservation under the Marine Reserves Act 1971. The Act allows areas of territorial sea to be set aside for scientific study where they contain special features. Customary fisheries management arrangements such as *mataitai* reserves or *taiapure* are both available under the Fisheries Act. 1996.

Discussion Questions

In the context of fishery resources, what are the criticisms of maximum sustainable yield?
Name and define two current fisheries laws (or acts) in New Zealand and describe how they are applied.
Which coastal waters (or coastal setting) are most affected by human activities?
What are the environmental effects of sediment contamination of waterways?
What are the drawbacks or weaknesses of the Quota Management System?
What is bottom trawling and what are its environmental impacts?
Why does sustainable fishing in New Zealand require more than just sustaining the yield from a particular target fish stocks?
Why is coastal erosion one of the main coastal hazards in New Zealand?
Are coastal ecosystems under-represented in protected areas in New Zealand?
Who should be responsible managing the marine environment beyond the 12 nautical mile limit of the territorial sea?
What is the difference between *mataitai* reserves and *taiapure*? Is this difference controversial?

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Chapter 8
The Air

Key Questions

- What climate conditions prevail in New Zealand at the regional scale?
- Does New Zealand suffer from air pollution? If so, what are its characteristics and causes?
- What are the sources New Zealand's greenhouse gas emissions (other than water vapour) and what trends can be identified?
- What are the environmental impacts of national trends in energy supply and energy use?
- How successful are New Zealand's energy efficiency policies?
- What are food miles?
- Does New Zealand have an overarching framework or strategy on energy policy and direction?
- What evidence is there that New Zealand's climate is being affected by 'global warming'?
- How well has New Zealand performed over last few decades as far as managing the atmospheric environment is concerned?

Abstract New Zealand's location in the strong prevailing southwesterly wind belt and its relatively small industrial economy and population means that it generally has good air quality. But this is not necessarily the case in the nation's major urban centres. Indicators of air quality show that conditions in the main urban regions areas are generally poor. Legislation controls on the most important source of air pollutants, namely motor vehicles, remains weak. Fine airborne particles and carbon monoxide are the main pollutants. New Zealand's total greenhouse gas emissions rose by almost 20% from 1990 to 2009. Emissions data show that New Zealand is not typical of developed nations in that almost half of total emissions in 2009 were produced by pastoral-land activities. There is an increasing dependence on fossil fuels, although electricity from hydro generation continues to dominate energy consumption.

C.R. de Freitas and M. Perry, *New Environmentalism: Managing New Zealand's Environmental Diversity*, DOI 10.1007/978-1-4020-8254-2_8,

Decoupling indicators suggest that New Zealand's economy is reducing its reliance on energy while sustaining growth. Food miles and carbon footprint indicators can be used to show that energy efficiency in the agricultural sector in New Zealand compares well against other producers.

Key Concepts and Terms Air pollution • Carbon credits • Carbon dioxide • Carbon monoxide • Chlorofluorocarbons • Decoupling indicators • Energy efficiency policies • Energy policy • Energy use • Exceedances • Fine airborne particles PM_{10} and $PM_{2.5}$ • Food miles • Fossil fuels • Global warming • Greenhouse gases • Halons • Kyoto protocol • Lead • Methane • Motor vehicle emissions • Oxides of nitrogen • Ozone • Renewable energy • Sulphur dioxide • Volatile organic compounds

8.1 Climate

The atmosphere as portrayed by climate is a key feature of the physical environment. It is a free natural resource base for generating national income that can be exploited to enhance human wellbeing. For example, combinations of solar radiation, precipitation and air temperature can determine the extent to which agricultural activities might produce economic returns. In these terms, there are large parts of New Zealand where the climate resource base provides the potential for enormous financial returns, such as dairy farming in the Waikato region of the North Island provided that inevitable variations in climatic conditions are allowed for. Over-intensification of dairy farming can have enormous negative environmental consequences (see Chap. 5). Climate also sets limits on certain human activities that should be taken into account in environmental policies and management strategies. For example, locations with a climate characterised by a high frequency of stable atmospheric conditions are poorly ventilated, consequently, air pollutants are not effectively dispersed. There are parts of New Zealand where this is the case, such in the vicinity of Christchurch in the South Island, where subsidence inversions in the lee of the Southern Alps give rise to long periods of stable air associated with high air pollution potentials.

New Zealand's climate varies from cool subtropical in the far north to cool temperate in the far south, with alpine conditions in the mountainous areas. The Southern Hemisphere westerlies affect the country for most of the year, although, at certain times, easterlies may predominate. In the North Island, winds usually decrease in the summer and early autumn but in many parts of the South Island, the winter is the least windy season. Mountains extending much of the length of the west coast of the South Island and in the central part of the North Island interrupt the flow of the moist, cool prevailing southwesterly winds, dividing the country west-to-east into quite different climate regimes. The West Coast region of the South Island is the wettest area of New Zealand, whereas the area to the east of the mountains, just over 100 km away, is the driest.

Most parts of the country receive on average between 600 and 1,600 mm of rainfall annually. The highest rainfall occurs on the western slopes of the mountains where they are directly exposed to the prevailing southwesterly winds. Over the northern and central areas of New Zealand, more rainfall occurs in the low-sun half of the year than in the high-sun half, whereas for much of the southern part of the country, the low-sun season is the period of least rainfall. The rule of thumb is that rainfall during winter decreases southward. The greatest contrast is found in the north, where in places the low-sun half of the year has almost twice as much rainfall as the other half of the year. The southern half of the South Island excluding the west coast receives the least rainfall. A summer rainfall maximum occurs in the inland areas of southern half of the South Island due to the effect of convectional showers. Snow rarely falls in the lowland areas of the North Island and west of the South Island, although the east and south of the South Island may experience some snow in winter.

Mean annual air temperatures range from 10°C in the south to 16°C in the north of New Zealand. The coldest month is normally July and the warmest month is typically January or February. Other than in the mountains, there are relatively small variations between summer and winter temperatures throughout the country. However, in inland areas and to the east of the ranges the variation is usually up to 14°C. Sunshine hours are relatively high in areas east of the main mountain ranges. Ultraviolet solar radiation intensities in spring and summer are relatively high in most places, especially in northern New Zealand and in mountainous areas. Frosts can occur anywhere in the country, but rarely in the far north.

Most areas of New Zealand are well ventilated by prevailing southwesterly winds, but interaction between wind and highland give rise to distinct climate regions that affect the dispersal of air pollutants or produce clear sky conditions conducive to photochemical smog formation. These are regions are the eastern North Island, northern South Island, eastern South Island and Central Otago of inland South Island.

The above descriptions refer to average or perceived normal conditions. But climate is naturally variable and always changing, either warming or cooling, or becoming wetter or drier. The notion of a constant climate is misleading. Climate can change as a result of natural and human factors. The latter can be due to urbanisation, change in reflectivity of the land surface due to agriculture and other forms of land use, and particulate and gaseous emissions into the atmosphere.

8.2 Climate Change

Despite widespread claims to the contrary, global air temperature trends are not well correlated with changes in concentration of carbon dioxide (CO_2) in the atmosphere. According to the Intergovernmental Panel on Climate Change (2007), air temperature measurements taken at the surface of the Earth show that the average temperature of the globe has increased by about 0.6°C over the past century. Expressed on an annual basis, this averages about 0.006°C/year, an increase that is not measurable by standard thermometers. A large portion of this rise occurred before 1940, both

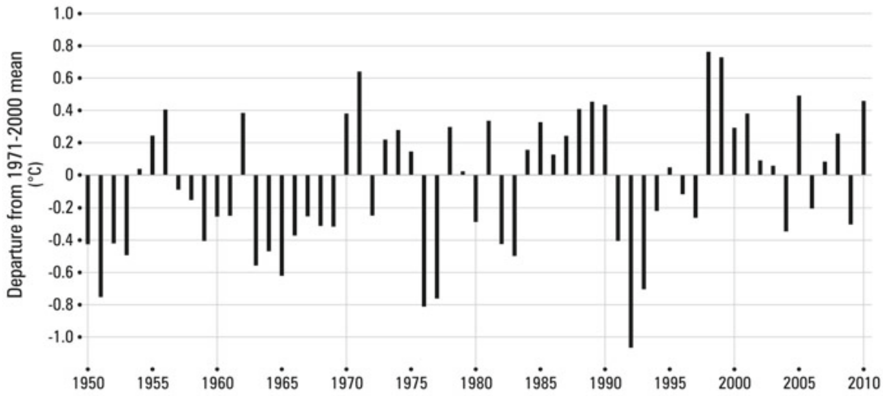

Fig. 8.1 Mean temperature anomalies over New Zealand 1950–2010. The bars show annual differences from the 1971–2000 average. These data are used by NIWA for tracking New Zealand's temperature trends, based on air temperature measurements from seven climate stations around the country that have long records, namely, Auckland, Masterton, Wellington, Hokitika, Nelson, Lincoln, and Dunedin

globally as well as in New Zealand, but most of the CO_2 from human activity entered the atmosphere after 1940. For roughly 40 years from about 1940 to 1978, the Earth's atmosphere cooled despite increasing levels of CO_2. According to Mahlman (1997), over the past 100 years, all changes in climate have been within the range of the climate's natural variations. Air temperatures in New Zealand as a whole over the past 50–60 years show that there is some warming and some cooling, but no significant warming trend is apparent (Fig. 8.1) (Box 8.1).

Box 8.1 Discussion Point: Challenge to the Validity the New Zealand Temperature Record (Source: Brill 2010a, b)

The National Institute for Water and Atmospheric Research (NIWA) is the agency responsible for maintaining the New Zealand Temperature Record (NZTR). In 1999, NIWA adopted a "Seven Station Series" (7SS) made up of seven locations considered to represent New Zealand. The NZTR is used by the Government to set and in part justify national climate policy, including legislation such as the ETS, transport and land use issues, consideration of taxes on energy and has been the basis of evidence given to the Environment Court and other legal panels. Temperature trends gleaned from the NZTR have played a part in the 'detection and attribution' arguments in climatology which seek to identify warming linked to human causes. The 7SS shows a warming trend of approximately 1.0°C during the past 100 years, which is above the global average for that period. Warming in the Southern Hemisphere is expected to be below that of the global average because it is dominated by oceans, which suppress warming and cooling. As there are very few long term

(continued)

Box 8.1 (continued)

temperature records in the Southern Hemisphere, the NZTR plays an important role in determining multi-decadal trends in hemispheric temperature trends and consequently global average temperatures.

It appears that the upward trend in the 7SS graph data might be caused by downward adjustments in the data prior to 1945, rather than by upward adjustments thereafter. The New Zealand Climate Science Coalition (NZCSC) queried the basis of the 7SS, but was unsuccessful in discovering how data were assembled and adjusted to account for changes at a climate stations, or when a climate station site was moved. The need for clarification was highlighted by the fact that earlier research by Hessell (1980: 1) found that "A systematic analysis of all New Zealand climatological stations [not affected by shelter, screenage and urbanisation] with sufficient length of record reveals that no important change in annual mean temperature since 1930 has been found." Various attempts were made to require NIWA to replicate the adjustments and publish the details. When this was still not done by August 2010, the NZCSC decided to seek a legal solution with the rationale that, if the final documentation supports the official record, this will give confidence to users of the 7SS data. If it does not, then the public will be enlightened and it is likely to impact on public policies such as the ETS.

Critical thinking question: NIWA's 7SS graph shows New Zealand has warmed 0.91°C in 100 years, which is over 50% larger than data cited by IPCC for the Southern Hemisphere. What are possible reasons for this?

The science of climate change depends entirely on reliable data to validate numerical climate simulation models and to identify fluctuations and trends. This involves complex calculations but is equally affected by practical difficulties recording air temperature that is representative of a large area. The best-documented example is the 'urban heat island' effect, in which data from urban stations can be influenced by localised warming due to asphalt and concrete replacing grass and trees. This can account for an urban area being as much as 13°C warmer than its rural surroundings. Surprisingly, trends in New Zealand urban areas show little evidence of warming; for example, the data for Christchurch, a city of 385,000 population shows temperature has remained relatively stable over the past 100 years.

The retreat of some New Zealand glaciers have been used as evidence of warming, but research has shown that glacial retreat is more closely linked to snowfall than to air temperature (Chinn et al. 2005). In the case of the Franz Joseph glacier, Hessell (1983) found no significant statistical relationship between temperature in New Zealand and glacial retreat. In recent times New Zealand's the Fox and Franz Josef Glaciers have been growing, while the Tasman glacier has been retreating. Many of New Zealand's glaciers advanced between 1980 and 2000 and showed their greatest retreat in the 1950s.

Accelerated sea level rise is one of the most concerning impacts of global warming, but there is no evidence of accelerated sea level rise in New Zealand for the past 100 years (Hannah 2004). Despite this, the Ministry for the Environment recommends that coastal assessments by local bodies consider the consequences of a mean sea-level rise of at least 0.8 m relative to the 1980–1999 average for New Zealand. This is reflected in the legislation passed by several local bodies that restricts development on certain coastlines, rejects consents for alterations or extensions to existing buildings in the coastal zone, discourages the construction of defences such as sea walls, or insists on plans for managed retreat. This planning response is based on an estimated global average [eustatic] sea level rise. It could be argued that this figure has little or no practical policy value. What matters in New Zealand are changes in local relative sea-level (LRSL), which alone is relevant for purposes of coastal planning. LRSL is highly variable depending on where you are along the large New Zealand coastline, some of which is undergoing experiencing tectonic uplift or subsidence. For this reason there is no meaningful way of averaging LRSL: rather potential sea level change has to be determined relative to local conditions.

8.3 Monitoring and Managing Air Quality

New Zealand's location in the strong prevailing southwesterly wind belt and its relatively small industrial economy and population means that it generally has good air quality. Major urban centres are the main exceptions; in particular, Auckland as regards air pollution from transport and Christchurch because of emissions from road vehicles and household fires. Regional councils have mechanisms available under the Resource Management Act to deal satisfactorily with the point source discharges, both large and small, but these mechanisms are largely ineffective on motor vehicle emissions. This remains one of the major problems in successfully managing New Zealand's atmospheric environment.

New Zealand's population is projected to reach five million by 2050 and most people will reside in urban areas. In 2006, around 85% of the country's population lived in cities. Over half the urban population lives in the Auckland region which provides 60% of the nation's economic output. New Zealand, along with Australia, Japan, North America, and the countries of northwest Europe, has one of the highest vehicle ownership rates in the world. Motor vehicles are responsible for air pollution in heavily used traffic corridors and are secondary contributors to winter-time ambient pollution, which is primarily caused by domestic fires. In Christchurch, both causes are amplified by the temperature inversion layer which prevents pollutants from dispersing. In 2005, New Zealand's rate of car ownership rose to the third highest in the world at 607 cars per 1,000 people (Table 8.1). In 2005, 70% of cars were used imports. The mean age of vehicles in New Zealand has been rising steadily and older cars generally pollute more (Fig. 8.2). The number of licensed vehicles in New Zealand has grown at more than twice the rate of the human population since 1972.

A study carried out for the Ministry of Transport in 2002 (Fisher et al. 2002; Scoggins et al. 2004) estimated that 970 people above the age of 30 years die

Table 8.1 Car ownership per 1,000 inhabitants

Rank	Country	Cars per 1,000 population	Rank	Country	Cars per 1,000 population
1	Luxemburg	647	11	France	494
2	Iceland	632	12	Portugal	471
3	New Zealand	607	13	Belgium	468
4	Italy	595	14	United States	461
5	Canada	561	15	Finland	460
6	Cyprus	550	15	Sweden	460
6	Germany	550	16	Britain	451
7	Australia	542	17	Spain	445
8	Malta	523	18	Japan	441
9	Switzerland	520	19	Norway	439
10	Austria	503	20	Lithuania	426

Source: *The Economist* (2009)

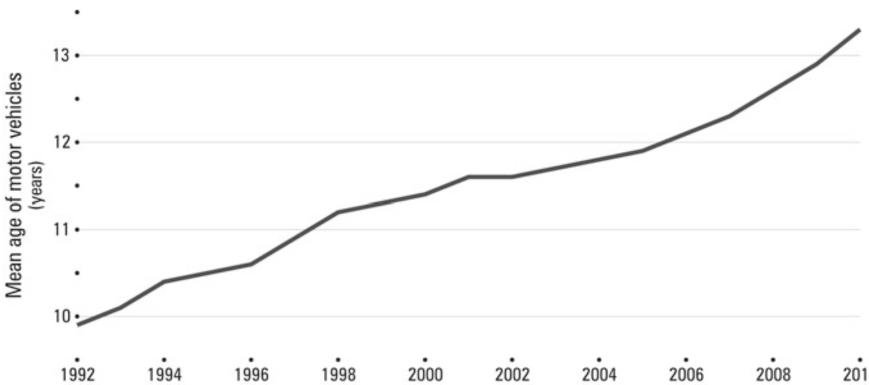

Fig. 8.2 Mean age of registered road motor vehicles in New Zealand, 1992–2010. Data from Land Transport New Zealand http://www.ltsa.govt.nz/

prematurely each year from exposure to air pollution and 436 of these deaths occur in the Auckland region (Box 8.2). A similar study specifically for Christchurch found that there are 158 premature deaths annually that city. The most sensitive individuals include older people (particularly those over 65) infants (particularly those under 1 year old), asthmatics and people with bronchitis, people with other respiratory problems, and people that are health compromised in other ways such as those with heart disease. New Zealand is one of the few developed countries in the world without strict motor vehicle emission standards and checks. After 2 years of study, in May 2005 the Government decided against testing of motor vehicles to check for emissions which contribute to human health problems. The fall-back plan is a new rule on vehicle imports. From 1 January 2012, all vehicles imported from Japan must be a 2005 or later year model. The object is to ensure New Zealand imported a greater proportion of used cars with more up-to-date emission controls, safety features and fuel-efficient engines.

Box 8.2 Discussion Point: Emissions Make Most of Us Fume (Source: de Freitas 2005)

Air pollution episodes at levels that exceed national and international air quality guidelines are relatively common in New Zealand's large urban areas. Motor vehicles are the major contributors to dirty air. For this reason most countries in the developed world have strict legislation to control vehicle emissions at their source. It is an alarming fact that New Zealand does not, with one exception. From March 2001 a law called "the 10-second rule" allows police to issue a $150 fine to the driver of a vehicle that discharges from its exhaust clearly visible smoke or vapour for 10 s or more. The law reflects the naïveté in dealing with the very serious matter of urban air pollution in New Zealand, as not all exhaust emissions are visible. Moreover, the most harmful ones are too small to see.

As far back as 1965, the then Auckland Air Pollution Research Committee recognised motor vehicles as a major source of air pollutants in the region. Decades went by before anything at all was done. In 1986, the lead content of gasoline used in New Zealand was a startling 0.84 g/L, one of the highest levels in the world. Its residues were detectable even on country roadsides. Given that lead is a dangerous toxin that acts on the human nervous system, the government eventually responded to public concern. In 1987 the lead level in petrol was reduced to 0.45 g/L and totally eliminated in 1996, well after most other OECD countries had done this.

Lead has now gone from petrol, but other poisons remain. Exhaust emissions produce large quantities of particulate matter, oxides of nitrogen, carbon monoxide and hydrocarbons. Diesel engines are inclined to be dirtier than petrol engines. They produce a disproportionate number of small particles that penetrate deep into the lungs. While efforts in New Zealand to enact emissions legislation are stalled, strict vehicle emission control legislation has been in place for decades over most of the developed world.

Critical thinking question: What may explain the absence of air pollution controls?

The high sulphur content of petrol and diesel, which is known to lead to harmful emissions, is another example of New Zealand's poor environmental report card when it comes to air quality. New Zealand regulations allow 3,000 ppm of sulphur in diesel fuel. In most countries of northwestern Europe, the maximum permitted limit was reduced from 350 to 50 ppm in 2005. In California the limit in 2006 is 30 ppm and the national administration is pushing for a United States wide maximum sulphur content of 15 ppm. In contrast, the New Zealand government has required diesel and petrol sold in New Zealand from 2006 to have a maximum sulphur content of 50 ppm.

Table 8.2 Ministry for the Environment Environmental Performance Indicators (EPI) of air quality used to help interpret the significance of air pollutions concentrations in the urban and industrial regions of New Zealand

Action	Breaches of the guideline	Unacceptable by national and international standards
Alert	66–100% of guideline	A warning level which can lead to excesses if trends are not curbed
Acceptable	33–66% of guideline	Maximum values may be of concern in some sensitive locations, but are generally at a level which does not warrant dramatic action
Good	10–33% of guideline	Peak measurements in this range are unlikely to impact on air quality

Source: Auckland Regional Council (2001)

In other areas there has been progress in managing New Zealand's air quality. Fourteen standards for the prevention of toxic emissions and the protection of air quality were introduced in October 2004. Seven standards are for dioxins and toxins, and include bans on: burning of tyres in the open; bitumen burning for road maintenance; burning of coated wire in the open, burning of oil in the open; landfill fires; and high-temperature hazardous waste incinerators. Five standards are for air quality that deal with the pollutants smoke and soot (fine particles, called PM_{10}), sulphur dioxide, carbon monoxide, nitrogen dioxide and ozone. One standard is for the design of new domestic wood burners in urban areas that can be sold for residential use to minimise emissions of smoke and soot. Another standard requires landfills of over 1 million tonnes to collect and destroy landfill gas to help reduce greenhouse gases. The use of school and hospital incinerators was prohibited from September 2006 unless special resource consents are obtained beforehand. Also, since September 2005, regional councils must monitor air quality and publicly report if the air in their region exceeds standards set by the council.

8.3.1 Indicators and Standards

To assist in monitoring and managing the quality of the atmospheric environment in the main urban and industrial regions of New Zealand, the Ministry for the Environment has set out "Environmental Performance Indicators" (EPI) of air quality to help interpret the significance of air pollution concentrations (see Chap. 4). The EPIs define four conditions: "action", "alert", "acceptable" and "good" (Tables 8.2 and 8.3). The EPI "action" is a measured breach of the guideline and means conditions are unacceptable by national and international standards. "Alert" is measured concentrations at 66–100% of the measured guideline and means warning level which can lead to excesses if trends are not curbed. "Acceptable" is measured concentrations at 33–66% of the guideline and means maximum values may be of concern in some sensitive locations, but are generally at a level which does not

Table 8.3 Auckland regional air quality targets at traffic and industrial sites for contaminant concentrations of particles under 2.5 µm ($PM_{2.5}$), particles under 10 µm (PM_{10}), nitrogen dioxide (NO_2), carbon monoxide (CO), sulphur dioxide (SO_2) and Benzene

Contaminant	Air quality target	2,000 levels	Averaging time
$PM_{2.5}$	25 µg m^{-3}	Action	24 h
PM_{10}	50 µg m^{-3}	Action	24 h
NO_2	200 µg m^{-3}	Action	1 h
	100 µg m^{-3}	Action	24 h
CO	30 mg m^{-3}	Action	1 h
	10 mg m^{-3}	Action	8 h
SO_2	40 µg m^{-3}	Good	24 h
Benzene	3.6 µg m^{-3}	Alert	Annual

Source: Auckland Regional Council (2001)
Notes: The targets apply to traffic monitoring sites within 2–5 m of a roadside in areas subject to high traffic flow, congestion and/or containment. These targets also apply to heavy industrial areas. See text for interpretation of pollution levels

Table 8.4 National Environmental Standards (NES) include five standards for outdoor air quality

Pollutant (averaging period)	New Zealand	Australia	European Union
Particulate matter (PM_{10}) (24-h)	50	50	50
Nitrogen dioxide (NO_2) (1-h)	200	256	200
Ozone (1-h)	150	210	170
Sulphur dioxide (SO_2) (1-h)	350	570	350

Source: Ministry of Transport (2004)
The NES have the force of a regulation and came into effect on 1 September 2005. The New Zealand NES for air quality are shown and compared with other international standards. Data are in µg m^{-3}

warrant dramatic action. "Good" is concentrations at 10–33% of the guideline and means peak measurements in this range are unlikely to impact on air quality.

The Ministry for the Environment National Environmental Standards (NES) are mandatory 'bottom-line' regulations that apply nationally (Ministry of Transport, 2004). NES regulations that came into force on 1 September 2005 include five standards for outdoor air quality (Table 8.4). Agencies responsible for managing emissions to air under the Resource Management Act 1991 will be accountable for ensuring that those standards are met, and may be used as a criterion for any resource consent applications for activities that emissions that pollute the air.

Key air pollutants are measured in four urban-industrial regions of New Zealand, namely, Auckland, Canterbury and Wellington Regions and Rodney District. The air pollutants measured are fine particles ($PM_{2.5}$ and PM_{10}), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3) sulphur dioxide (SO_2), lead and benzene. Volatile organic compounds (VOCs) are also measured in the Auckland Region. National Environmental Standards for air quality (NES) were introduced by the Ministry for the Environment in October 2004 (Ministry for the Environment 2005). These along with EPIs of air quality are used to assess the frequency standards are exceeded and trends.

8.3.2 Fine Airborne Particles

PM_{10} are very small particles less than 10 μm in diameter suspended in the air that are invisible to the human eye. These particles can affect health, especially in asthmatics and people with heart and lung disease. Particles can carry carcinogenic material into the lungs. High concentration of PM_{10} are associated with an increase hospital admissions and emergency department visits, school absences, lost work days and restricted activity days. Kunzli and Tager (2000) have calculated that PM_{10} causes a 4% increase in deaths for every 10 μg m^{-3} increase in its average annual concentration (above the baseline level of 7.5 mg m^{-3}). This is a relatively small increase in the risk of death for each individual, but the cumulative effects are important because of the large numbers of people exposed to air pollution.

Alert levels are reached at all monitoring sites in the Auckland region. There are also breaches of the guideline at monitoring sites during winter. $PM_{2.5}$ is four times smaller than PM_{10} and is even more damaging to human health. There are regular breaches of guideline for $PM_{2.5}$. Diesel motor vehicles are the main source of fine particulate, especially $PM_{2.5}$ and conditions are worst in winter. According to the Auckland Regional Council (2006a) concentrations of PM_{10} measured in Auckland have exceeded both the NES of 50 μg m^{-3} (24-h average) and the ambient air quality guideline of 20 μg m^{-3} (annual average). It is noteworthy, however, that PM_{10} and $PM_{2.5}$ have no 'safe threshold'.

Limited information is available on trends in small particle emissions in New Zealand owing to the relatively recent nature of the use of emission inventories. The longest dataset is not much over 10 years. Domestic home heating is the main source of wintertime PM_{10} emissions, thus changes in types of home heating will play a key role in determining trends in most areas. Some data for Christchurch and Timaru suggest little changes in emissions between the years 1996 and 2000 (Ministry for the Environment 2003a). However, changes in emissions from motor vehicles will also determine national trends in PM_{10} emissions. The New Zealand Transport Emission Rate model (NZTER) produced by the Ministry of Transport as a part of the vehicle fleet emission control strategy indicates a future reduction in particle emissions from this source due to improved vehicle technology.

In September 2011 the World Health Organization (2011) released a compilation of outdoor air quality data from almost 1,100 cities in 91 countries. Air quality is represented by annual mean concentration of PM_{10} and aims to be representative for human exposure in that it captures measurements from monitoring stations located in urban background, urban traffic, residential, commercial and mixed areas. The data show that the world's average PM_{10} levels by region range from 21 to 142 μg m^{-3}, with a world's average of 71 μg m^{-3}. WHO's recommended maximum is 20 μg m^{-3}. Data for New Zealand cities, as reported for New Zealand by the Ministry for the Environment, are given as Auckland 15 μg m^{-3}, Hamilton 13 μg m^{-3}, Wellington 11 μg m^{-3}, Christchurch 17 μg m^{-3} and Dunedin 25 μg m^{-3}. However, data based on mean annual concentrations can be quite misleading. For example, none of the cities listed above are located within airsheds in New Zealand with the 10 highest 24-h average PM_{10} levels between 2005 and 2010, except Christchurch. Moreover, all of the airsheds recording the highest number of exceedances (above the 24-h ambient air quality standard of 50 μg m^{-3}) that consistently appeared in the top 10 list from 2005 to 2010 are located in the South Island (Christchurch, Kaiapoi, Central Otago, Timaru). The highest national recorded daily PM_{10} level has shown a steady downward trend, dropping from 198 μg m^{-3} in 2005, to 148 μg m^{-3} in 2010. Nevertheless, the Ministry for the Environment accepts that levels can vary largely from year-to-year due to meteorological variation and this trend may have been influenced by such variation.

8.3.3 Carbon Monoxide

Carbon monoxide (CO) is poisonous as it interferes with the blood's ability to absorb and circulate oxygen and can be lethal. At certain concentrations CO can affect people with heart conditions such as angina and can impair co-ordination and concentration. Motor vehicle emissions and domestic heating are the main sources of CO in most urban areas of New Zealand. However motor vehicles are the most significant cause of peaks episodes of carbon monoxide levels and there are regular breaches of the guideline at traffic sites. Maximum CO concentrations are generally less than the NES at urban monitoring sites (i.e. 'non-traffic' sites) in the Auckland region. Levels at roadside sites have dropped since the 1980s, but still may occasionally exceed ambient air quality guidelines (Auckland Regional Council 2006).

Changes in home heating methods will influence trends in CO emissions in most areas but changes in vehicle technology and fuels will dominate (Ministry for the Environment 2003b). Some trends in CO emissions from motor vehicles can be assessed based on the estimated impacts of changes in vehicle technology and fuels. The NZTER points to future reduction in carbon monoxide emissions from motor vehicles. The reductions are primarily associated with improved vehicle technology. The three levels of service (LOS) categories represent emission rates for different levels of congestion. Figure 8.3 provides a comparison of concentrations of carbon monoxide in Auckland and London for the period 1998 to 2004. It shows that carbon monoxide concentrations in London are declining steadily, whereas this is not the case in Auckland. For the present, a major point of difference between New Zealand urban areas and most cities in developed countries elsewhere in the world is the relatively high concentrations of carbon monoxide.

8.3.4 Oxides of Nitrogen

Oxides of nitrogen (NO_x) is the generic term for a group of highly reactive gases that include nitrogen dioxide (NO_2) and nitric oxide (NO). Nitrogen dioxide (NO_2) can irritate the lungs, increase the symptoms and severity of asthma and lower resistance to infections such as the flu. It can also affect plant growth and health and can reduce visibility as it plays a part to the formation of brown hazes and smog. NO is an important contributor to the formation of ozone, which is dealt with later.

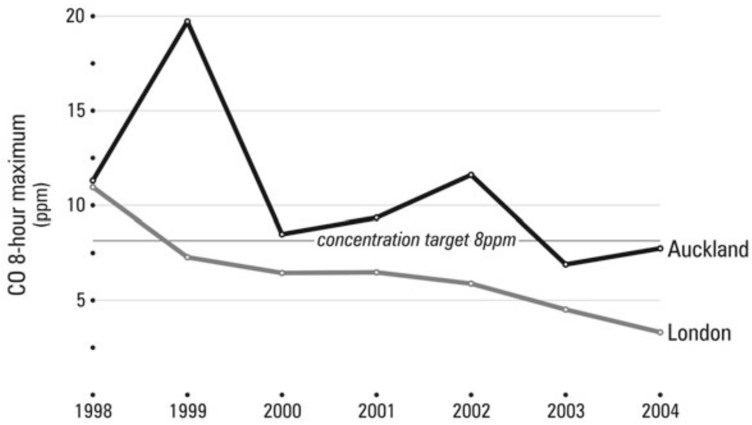

Fig. 8.3 A comparison of carbon monoxide concentrations at the worst sites in London (England) and Auckland in relation to the concentration target for the period 1998–2004. Source: Auckland Regional Council (2006)

Emission inventory studies show that the main source of NO_x emissions in most urban areas of New Zealand is motor vehicles, although industry is dominant in some regions (Ministry for the Environment 2003b). There are frequent breaches of the guidelines for NO_2 in Auckland and Christchurch and levels are increasing. According to the Auckland Regional Council (2006), motor vehicles are the main source of nitrogen dioxide in the Auckland Region. NO_2 concentrations are generally less than 66% of the NES at urban monitoring sites in the Auckland region but frequently exceed the standard at roadside monitoring sites. Generally speaking, NO_2 concentrations in Auckland increased over the decade 1995–2005.

Given that motor vehicles are the main source of NO_x emissions in most urban areas of New Zealand changes in emissions from motor vehicles will be key drivers in NO_x concentrations trends. An estimate of the impact of improved vehicle engine technology on NO_x emissions over the next 20 years has been provided by the Ministry of Transport, which indicates significant decreases in NO_x emissions in New Zealand. The three levels of service categories represent emission rates for different levels of traffic congestion. Comparison of concentrations of nitrogen dioxide in Auckland and London show that they have sometimes been higher in Auckland (Fig. 8.4). More recently, concentrations in Auckland's have fallen well below those in London.

8.3.5 *Ozone*

High up the atmosphere, a layer of ozone in the stratosphere protects life on Earth from harmful ultraviolet radiation from the Sun. New Zealand ratified the Montreal Protocol on Substances that Deplete the Ozone Layer in 1987, promising to stop using chemicals that are believed to lead to the depletion of the ozone layer (Box 8.3).

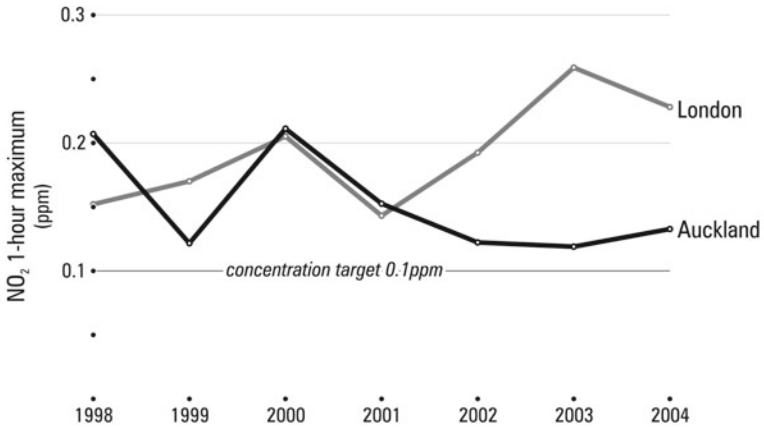

Fig. 8.4 A comparison of nitrogen dioxide concentrations in London (England) and Auckland in relation to the concentration target for the period 1998–2004. Source: Auckland Regional Council (2006)

Ozone (O_3) is a toxic gas at ground level formed by reactions with oxides of nitrogen (NO_x) and hydrocarbons in the presence of sunlight. Ozone can lead to nose and throat irritations and breathing difficulties for asthmatics. Occasionally alert levels are reached at all monitoring sites in the Auckland region.

Box 8.3 Discussion Point: The Special Case of Methyl Bromide

New Zealand ratified the Montreal Protocol on Substances that Deplete the Ozone Layer in 1987, promising to stop using chemicals that are believed to lead to the depletion of the ozone high in the atmosphere that protects life on Earth from harmful ultraviolet radiation from the sun. The Montreal Protocol set timetables for the phase-out of specific chemicals numbers of synthetic chemicals that have been implicated in ozone depletion, the main category being chlorofluorocarbons (CFCs) and halons. A ban on the production of various CFCs and halons as required by the Montreal Protocol began in January 1996. New Zealand does not manufacture CFCs and halons, so assessment of use was based on import data. Imports of CFCs and halons have ceased but not methyl bromide, another ozone depleting gas covered by the Montreal Protocol. Use of this gas was to have been phased out by the end of 2004.

Methyl bromide is used to sterilise soil for the growing of crops such strawberries and toa lesser extent apples, tomato and cut flowers. New Zealand passed the Ozone Layer Protection Act 1996 to help meet its obligations. The target for 2003 was 75% of the 1991 consumption in preparation for a complete phase-out by 2005. In November 2004, the New Zealand Government applied

(continued)

Box 8.3 (continued)

for an exemption from the Montreal treaty to enable the continued use of methyl bromide on the grounds that growers had no economically viable alternative. The successful application was made in agreement with 10 other countries led by the United States. Degenerative motor neurone brain disease in humans has been linked with methyl bromide, meanwhile strawberry growers continue to use the gas.

Critical thinking question: Why was the 'ozone problem' easier to solve through international co-operation than the 'carbon dioxide problem'?

8.3.6 Sulphur Dioxide

Sulphur dioxide (SO_2) can irritate the lungs bringing about coughing and breathlessness. Asthmatics in particular may suffer from reduced airflow to the lungs when levels of SO_2 exceed guideline values (Auckland Regional Council 2006). The main source of SO_2 emissions in many urban areas of New Zealand is industry. However, motor vehicles are the dominant source in most areas where industrial activity is absent or small. SO_2 emissions from motor vehicles are dominated by emissions from diesel-powered vehicles. Changes in emissions from motor vehicles and industry will therefore determine future trends in SO_2 concentrations within New Zealand urban areas. Concentrations of SO_2 measured in the Auckland region are typically less than 33% of the NES (Auckland Regional Council 2006).

Prior to 2004, diesel fuel used in New Zealand contained up to 3,000 ppm of sulphur, which was high by international standards. This changed with the introduction of the Petroleum Products Specifications Regulations 2002, which required fuel providers to reduce sulphur levels in diesel to 500 ppm by August 2004 and to 50 ppm by August 2006. Since 2006, the sulphur content of petrol has been 150 ppm and there are moves to reduce it to 50 ppm in line with diesel. For motor vehicle emissions, factors such as increasing use of diesel vehicles and revisions to the fuel specifications will impact on SO_2 emissions.

8.3.7 Volatile Organic Compounds

Volatile organic compounds (VOCs) contribute to the formation of ozone in the atmosphere. VOCs also include air toxins such as formaldehyde and benzene, which can cause skin, throat and eye irritation, headaches, nerve and organ damage, and possibly increased risk of cancers. In most areas, domestic home heating and motor vehicles are estimated to be the main contributors to VOC emissions (Ministry for the Environment 2003b). In Gisborne, however, natural emissions are the dominant source of VOC emissions (Ministry for the Environment 2003b), in contrast with Taupo, Christchurch and Kaiapoi where industry is a significant contributor to VOC emissions. Limited monitoring of benzene shows that levels sometimes exceed the air quality guideline at roadside sites, but are within the guideline in other areas and the benzene content of petrol from 3% to 1% (Auckland Regional Council 2006). Government regulations required that the benzene content of diesel was reduced from 3% to 1% in August 2006.

8.3.8 Lead

Lead (Pb) is toxic and can cause serious health effects, particularly in young children. Lead can also affect the nervous system, the brain and kidneys. Lead in the air has been measured in Auckland since 1973 and data show it has reduced to levels well below the Ministry for the Environment guidelines since the reduction of the level of lead in petrol in 1986. It was completely phased out as a gasoline additive in 1996.

8.4 Greenhouse Gases

Total emissions of greenhouse gases include those from the energy, industrial processes, solvent and other product use, agriculture and waste sectors, but do not include emissions and removals from the land use, land-use change and forestry (LULUCF) sector. Net emissions are total emissions and emissions and removals from the LULUCF sector. New Zealand produces approximately 0.2% of the world's greenhouse gas emissions and 0.12% of total world energy greenhouse gas emissions (Ministry of Economic Development 2010, 2011).

In 1990, New Zealand's total greenhouse gas emissions were 59,112.1 Gg carbon dioxide equivalent (CO_2-e). By 2009, total greenhouse gas emissions had increased by 19.4% to 70,563.8 Gg CO_2-e. Between 1990 and 2009, the average annual growth in total emissions was 0.9% per year (Ministry for the Environment 2011). In 1990, New Zealand's net greenhouse gas emissions were 35,661.0 Gg CO_2-e. In 2009, net greenhouse gas emissions had increased by 23.1% to 43,881.1 Gg CO_2-e (Ministry for the Environment 2011). During this time there have been changes in the relative amounts of the two main greenhouse gases emitted, namely methane (CH_4) and CO_2. CH_4 and CO_2 contributed equally to total emissions in 1990, but in 2009, CO_2 was the major greenhouse gas in New Zealand's emissions profile (Tables 8.5, Figs. 8.5, 8.6 and 8.7). This growth in emissions of CO_2 is due to growth in emissions from the energy sector (Tables 8.5 and 8.6).

Emissions data show that New Zealand is not typical of developed nations in that the agricultural sector makes the largest contribution to New Zealand's total

Table 8.5 Emissions of greenhouse gases in New Zealand in 1990 and 2009 showing percent change, where CO_2 is carbon dioxide, N_2O is nitrous oxide and CH_4 is methane

Greenhouse gas emissions	Gg CO_2 equivalent 1990	Gg CO_2 equivalent 2009	Percent change 1990–2009
CO_2	25,000.2	33,444.6	33.8
CH_4	25,303.5	26,136.2	3.3
N_2O	8,163.4	10,037.9	23.0

Source: Ministry for the Environment (2011)

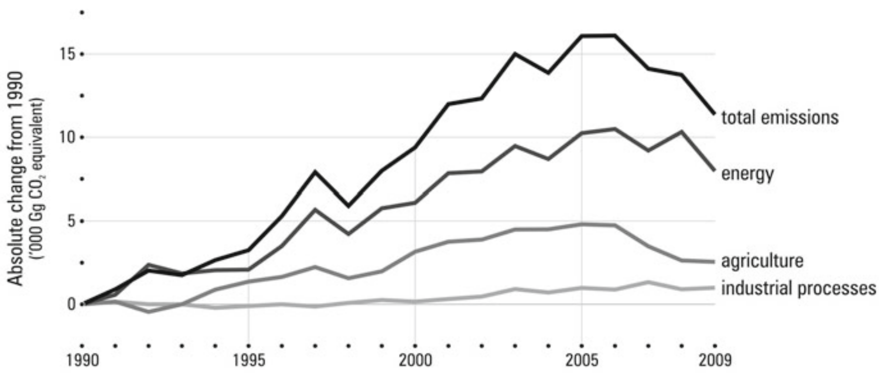

Fig. 8.5 Absolute change in greenhouse gas emissions 1990–2009 by sector of the New Zealand economy expressed as gigagrams of carbon dioxide equivalent. Source: Ministry for the Environment (2011)

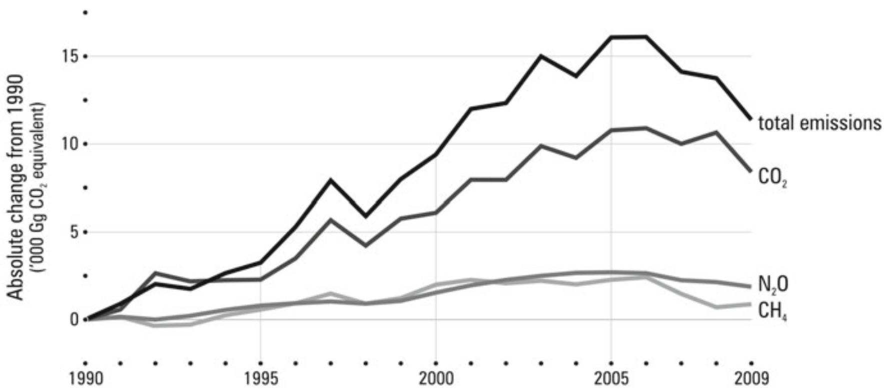

Fig. 8.6 Change in New Zealand's total emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) from 1990–2009 expressed as gigagrams of CO_2 equivalent (Ministry for the Environment 2011). Note values exclude emissions and removals from LULUCF

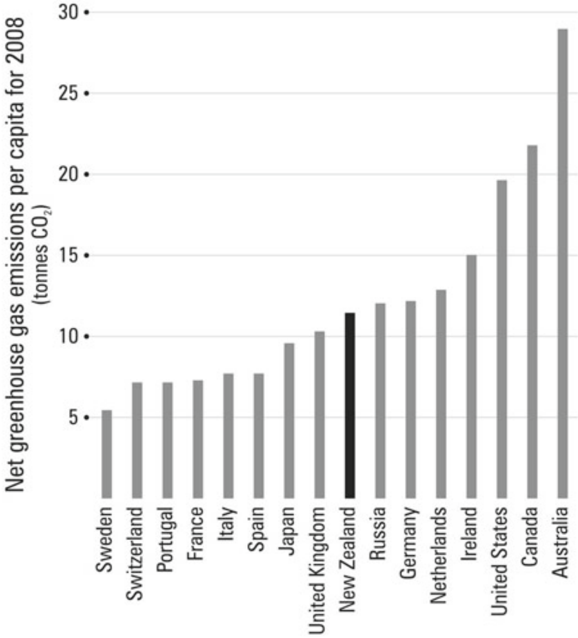

Fig. 8.7 Net carbon dioxide equivalent emissions per capita for selected countries in 2008. Source: Ministry of Economic Development (2010)

Table 8.6 New Zealand's greenhouse gas emissions in 2009 expressed as equivalent carbon dioxide emissions, showing percent change from 1990

Sector	Gg CO_2 equivalent 2009	Percent of total in 2009	Percent change 1990–2009
Agriculture	32,810.5	46.5	+8.4
Energy	31,361.4	44.4	+34.3
Industry	4,345.5	6.2	+28.5
Waste	2,018.4	2.9	−1.6

Source: Ministry for the Environment (2011)

greenhouse gas inventory at 46% as of 2009, just ahead of the energy sector at 44%, while industrial processes make up just over 6% (Ministry for the Environment 2011). By comparison, emissions from agriculture typically make up 12% of total greenhouse gas emissions across Annex 1 Parties (Ministry for the Environment 2006b). The agricultural emissions are predominantly CH_4 emissions from ruminant farm animals and nitrous oxide (N_2O) emissions from animal excreta and nitrogenous fertiliser use. Between 1990 and 2009 emissions from agricultural activities (CH_4 and N_2O) increased by about 8% (Table 8.5). The increase from 1990 to 2009 is primarily due to a 641.6 Gg CO_2-e (2.9%) increase in methane (CH_4) emissions from the enteric fermentation category and a 1,736.0 Gg CO_2-e (22.4%) increase in nitrous oxide (N_2O) emissions from the agricultural soils category. The next largest contribution to emissions is CO_2 emissions from road transportation, up 28% in 2009 compared with 1990 (Ministry for the Environment 2011).

Table 8.7 Annual emissions of greenhouse gases from selected countries in the world in 2007 compared to New Zealand's emissions, expressed a megatonnes of carbon dioxide equivalent

Countries	Percent world share	Percent change 1990–2007
United States of America	18.3	16.8
China	20.3	120.5
European Union (27)	13.0	–9.3
India	5.1	79.9
Japan	3.5	8.2
Brazil	2.7	54.7
Canada	1.9	26.2
Australia	1.4	30.0
New Zealand	0.2	22.1

Source: Ministry for the Environment (2009b)

The energy sector of the economy is responsible for the other large source of New Zealand's emissions, accounting for 44% of total emissions in 2009, at which time emissions were 7,992.76 Gg (34%) above the 1990 level (Ministry for the Environment 2011). The growth in energy emissions from 1990 to 2009 is primarily from road transport (an increase of 4931.7 Gg CO_2-e or 66.2%t) and electricity generation (2494.3 Gg CO_2-e, an increase of 72.1%). In contrast, emissions from the waste sector in 2009 were down 1.6% compared to 1990 and its emissions are 26% below the 1990 baseline, with most of the change being a result of improvements in solid waste disposal. Landfill fires are banned by law, and the larger landfills have a collection network for methane, the gas that is formed as organic waste breaks down. The greenhouse gas contribution from landfills was 2% in 2005 (Ministry for the Environment 2006a; Aldy, 2006).

New Zealand's overall performance can be assessed if carbon dioxide emissions per capita are used as an environmental indicator. On a per capita basis greenhouse gas emissions reduced from 1990 to 2009; in absolute terms they increased substantially. Within the increase there has been a significant redistribution in the relative importance of different sources of greenhouse gases. In 1990 New Zealand's population of 3.4 million produced about 62 million tonnes of carbon dioxide equivalents compared 74 million tonnes produced by a population 4.3 million in December 2009. Thus, as a nation, gross greenhouse gas production per head of population has fallen from 18 to 17 tonnes per person in the 19 years between 1990 and 2009. Figure 8.7 shows net carbon dioxide equivalent emissions per capita for selected countries in 2008.

8.4.1 Policy

New Zealand is a small player in the world as far a greenhouse gases are concerned, producing less than half of 1% of total global greenhouse gas emissions (see Box 8.4 and Table 8.7). This compares to the top three emitters of the United States of

Box 8.4 Discussion Point: Care Needed When Comparing Greenhouse Gas Emissions

Comparing greenhouse gas statistics depends on whether one uses total gross emissions or net emissions, whether figures are for carbon dioxide or all greenhouse gases expressed as carbon dioxide equivalent, or whether data are for per capita emissions. New Zealand produces less than 0.2% of total global greenhouse gas emissions (Ministry for the Environment 2011). This compares with 21% for USA, 15% for China (15%) and 14% for the European Union. From 1990 to 2009 New Zealand's total greenhouse gas emissions increased by almost 20%. In 1990 New Zealand's population of 3.4 million produced about 62 million tonnes of carbon dioxide equivalents compared 74 million tonnes produced by a population 4.3 million in December 2009. Thus, as a nation, greenhouse gas production per head of population has fallen from 18 to 17 tonne per person in the 19 years between 1990 and 2009.

Critical thinking question: How do recent per capita trends in total emissions from all greenhouse gases in New Zealand compare with those in other industrialised countries?

America (21%), China (15%) and European Union (14%). Nevertheless, New Zealand is a signatory to the Kyoto Protocol and is bound to limits its greenhouse gases emissions or pay a financial penalty if it fails to meet its reduction targets. The Kyoto Protocol commits developed industrialised nations (specifically 'Annex I Parties') that ratified the Protocol to limit their greenhouse gas emissions. The individual emissions targets of Annex I Parties are aimed to be equivalent to a total reduction in greenhouse gas emissions of at least 5% from 1990 emissions levels in the first commitment period from 2008 to 2012. The Kyoto Protocol took legal effect in New Zealand on 16 February 2005. The treaty requires that New Zealand reduce greenhouse gas emissions by 2012 to what they were in 1990.

Emissions may also be offset by increasing the amount of greenhouse gases removed by carbon "sinks," such as forests planted since 1990, or trading 'carbon credits' with businesses in other countries that are also committed to the Protocol (Amano and Sedjo 2003). The concept of environmental offsets and their potential problems when applied to greenhouse gases has been discussed in Chap. 2. Here we discuss issues relevant to New Zealand.

A carbon credit is a market term. One carbon credit is equivalent to a 1 tonne cut in carbon dioxide emissions (or the equivalent removal of CO_2 from the atmosphere). Carbon credits are measured in units of certified emission reductions (CERs). Each CER is equivalent to 1 tonne of carbon dioxide reduction. In effect, carbon credits are certificates awarded to countries for trading purposes, hence creating a real financial cost of emitting CO_2. Countries that have exceeded stated levels can either have local businesses cut down emissions, or borrow or buy carbon credits. Such a credit can be bought or sold in the international market at the prevailing market rate and a number of markets have been established to facilitate this including the Chicago Climate Exchange and the European Climate Exchange.

Carbon credits create a market for reducing CO_2 emissions by giving a monetary value to the emissions. The aim of the Kyoto Protocol is to mandate countries to set quotas for the maximum greenhouse emissions. Countries in turn enact laws that restrict or provide a quota on the maximum emissions a business can have. Those who exceed their quota then need to buy credits from a carbon trading market. Under the New Zealand national allocation plan, each CO_2 emitter is given an allocation of how much CO_2 they are allowed to emit. If they exceed this, they must compensate by buying credits on the market from someone who is engaging in a practice that removes carbon from the atmosphere on a long-term basis (such as forest planting), or a business that has cut its emissions more than it was required to. A carbon credit can be quantified in terms of "carbon dioxide equivalent" (CO_2-e), which is a way of converting the different types of greenhouse gases into a common unit. Unlike carbon taxes, which set a price of CO_2 emissions via carbon budgets, carbon trading sets the volume and leaves it to the market to sort out the price. It is important to note that the entire purpose of the Kyoto Protocol is not to eliminate greenhouse gas emissions; rather it aims to inhibit increases in emissions following the base year of 1990.

The matter of carbon budgeting is complicated by the fact that New Zealand does not yet have a national forest inventory accurate enough for full Kyoto reporting, nor compliant with the Kyoto rules, nor does it have a map of land cover at 1990. Moreover, data on some greenhouse gas emissions are still limited and uncertain. Good data on carbon storage in pine plantations are available, but are lacking for indigenous forests and soils and pasture land. The matter of greenhouse gas budgeting is further complicated by the fact that methane is not absorbed by trees and the difficulty in determining how methane compares with carbon dioxide. It is worth noting that uncertainties are extremely high, so high in fact that one wonders if the data is suitable for decisions related to emissions trading and controls. For instance, for 2007 methane data, the Ministry for the Environment (2009a: 80) estimate "using the 95% confidence interval… the uncertainty in annual emissions was ±53%".

The Kyoto Protocol requires that New Zealand reduce greenhouse gas emissions by 2012 to what they were in 1990. But it is clear that the country is not on track to achieve this. Up until 2005, the rate of increase in emission was steadily upwards (Figs. 8.5 and 8.6). New Zealand had the second highest percentage increase of carbon dioxide emissions amongst the 23 OECD countries for the period 1990–2000. In 2008, New Zealand's greenhouse gas emissions exceeded those at 1990 by 23% (74.7 million tonnes of carbon dioxide equivalent).

The Kyoto Protocol allows a proportion of a country's carbon dioxide emissions to be offset by planting forests to soak up carbon. Initially, the New Zealand Government expected that short term forest sinks of carbon would cover the inevitable increases in the country's emissions of greenhouse gases, leaving a surplus of carbon credits to sell on the international market. The Government's hope was that New Zealand would claim credit for the carbon dioxide taken out of the atmosphere by trees and be left as a net absorber of carbon dioxide. This is permissible provided trees used for credit were planted since 1990 on land that was not previously forested. New Zealand treaty negotiators pushed for this stipulation to be written into the 1997 Kyoto Protocol at a time when new areas planted in trees in this country was at its peak, at about 100,000 ha in 1994. However, the rate at which land was switched to commercial forestry has declined rapidly to an estimated 15,000 ha in 2003. This is half the annual rate of 30,000 ha Government officials assumed when New Zealand ratified Kyoto. The country is unlikely to rapidly reverse this trend. Rural land prices continue to rise, increasing the cost of forestry investment beyond which investors find acceptable. Returns on sheep and beef farming continue to improve past the point at which land in pasture is more attractive than land in trees. The result: returns to tree growers will decline along with investment in this area.

In the past, both Labour-led and National-led governments have been accused of having no clear policy on "global warming". This is only partly true. The Resource Management (Energy and Climate Change) Amendment Act 2004 has allowed the effects of climate change, the efficiency of the end use of energy and the benefits derived from the use and development of renewable energy to be considered in resource management decisions. At one stage, proposals for a carbon tax were made but then had to be abandoned and the same happened with proposals for a methane tax. In both cases as a result of political campaigns opposed to taking action. The Permanent Forest Sink Initiative (PFSI) was introduced in 2007 having been discussed first in 2002 (Ministry of Agriculture and Forestry 2011: 19). The PFSI allows landowners to obtain carbon credits from forest that they covenant not to harvest or at least not to at a rate that does not maintain a continuous forest canopy.

The Projects to Reduce Emissions (PRE) programme was another early initiative. It offered support to projects or initiatives that reduce emissions of greenhouse gases beyond the reductions that would have occurred without PRE projects by issuing emissions units, or 'carbon credits'. PRE was confirmed by Cabinet in October 2002 with the New Zealand Climate Change Office given responsibility to administer the programme. The scheme can be seen as a first step toward emission trading. Projects and initiatives undertaken by businesses, groups or individuals that reduce greenhouse gas emissions are awarded emission units, or 'carbon credits' as an incentive to proceed. Subsequently, groups or individuals may sell the carbon credits they receive either to governments or to private buyers. Nine projects were allocated a total of four million tonnes of carbon dioxide credits in the first round in 2003. According the Parliamentary Commissioner for the Environment (Parliamentary Commissioner for the Environment 2005) the first initiative in PRE programme has enabled 15 renewable projects to get off the ground: four wind projects, four bio-energy (including landfill) projects, five small hydro projects, and two geothermal projects. PRE's success or otherwise can be assessed only when the projects are operational.

The failure to sustain support for a carbon tax had several origins, but it is significant that the country's major business interests had formed a Greenhouse Policy Coalition (see Box 8.5) that campaigned against it. The Coalition comprised mainly large

Box 8.5 Discussion Point: Big Business Opposes Climate Change Policy (Source: www.gpcnz.co.nz; Sundakov 2005)

The Greenhouse Policy Coalition was formed to lobby for the interests of energy intensive companies in relation to government policy on greenhouse gas and climate change issues. In 2005, the Coalition had 14 members that included most of New Zealand's largest industrial enterprises. In 2005, it released a report that argued against direct policy interventions such as carbon taxes and emissions targets. Promoting technological transformation and compliance with world-best energy efficiency standards for new capital investment were the favoured responses.

Among the reasons for opposing direct attempts to limit greenhouse gas emissions, it argues that industrial process emissions come mostly from a few large operations and that these companies can move their operations to countries where they would not face carbon taxes and price based measures. In this way the Coalition has sought to persuade the government not to use price-based instruments saying that the result would be a loss of business from New Zealand (and no gain for the environment as emissions simply move to another country).

Critical thinking question: The Greenhouse Policy Coalition raises the possibility that companies will move their operations away from New Zealand if they do not get the form of climate change policy they want. Does this indicate to you that the management of the New Zealand environment is made harder or easier by the comparative absence of big business?

emitters who saw that they had little scope to cut back on emissions within prevailing technology. For them a prospective tax was viewed merely as adding a cost burden and disadvantage in international markets. For example, in the dairy sector, large processing plants are more efficient users of energy than small plants but this is offset by the distance over which milk is transported for processing.

8.4.2 Emissions Trading Scheme 2010

New Zealand's Emissions Trading Scheme (NZETS) is a manifestation of its government's aspirational goal to reduce greenhouse gas emissions. The NZETS came into force on July 1, 2010, 5 years after that of the members of the European Union (EU), the only other countries in the world to have an ETS at the time. The EU's scheme does not cover all greenhouse gases. In its first stage the NZETS covers 23% of emissions. It may rise to cover all sectors (CO_2, methane and nitrous oxide) by 2015 depending on the outcome of reviews. A transition period will function run to the end of 2012 with the price of New Zealand emissions units (NZUs) capped at $NZ25, and only one unit to be surrendered for every 2 tonne of carbon-dioxide-equivalent emissions, effectively a cost of $NZ12.50 per tonne.

Critics of the ETS point out that emissions trading schemes were designed for industrial rather than rural economies like New Zealand where close to 50% of greenhouse gas emissions come from the agricultural sector and is made up largely of methane that cannot be reduced without reducing livestock agricultural activity. Moreover, about three quarters of New Zealand's electricity generation comes from renewable sources (hydro, geothermal, and wind) that effectively produce zero CO_2 emissions and thus cannot be 'cleaned up' via an ETS or any other scheme. The EU's ETS is not an "all gasses, all sectors" scheme like New Zealand's, since it excludes parts of the transport sector, households and small businesses, construction, agriculture and waste and is based solely on carbon dioxide. Apart from the EU, New Zealand's major trading partners have no comparable emissions trading scheme although Australia is introducing a limited form of carbon pricing in 2012. International negotiations in Durban, South Africa in December 2012 may provide a context in which more countries sign up to some form of carbon pricing. It agreed to an extension of the first phase of the Kyoto climate treaty – the only one that legally obliges wealthy countries to curb emissions – and a process to negotiate a new pact by 2015 that would come into force from 2020. Importantly, the new agreement is to include the world's top emitters: China, the USA and India. Immediately though critics of the NZETS say that even if the scheme works it will have little global impact as New Zealand's greenhouse gas emissions are less than 0.3% of the global total. At the time the NZETS came into effect the government accepted this, implying the main purpose of the NZETS is to enhance the country's green image, boost exports, attract tourists and increase its influence in global climate talks.

Carbon trading encouraged by the NZETS is intended to provide incentives for planting forests. Instead of having to wait for trees to mature before they can sell the timber, tree growers can receive payment for storing carbon well before harvest. How profitable carbon farming will prove to be depends partly on the compliance costs, which as well as insurance against losing trees to fires or disease, include the need for accurate record keeping. Partly as a consequence of international economic slowdown following the 2007 global financial crisis, carbon prices have fallen to a low level in 2011. Establishing a carbon forest in this environment brings the risk that there will be a much higher price on carbon when the trees are harvested than at the time the carbon was sold. For the moment, investing in trees for the purpose of getting income from carbon credits is a high risk activity. Nonetheless, it is interesting that the forest promoter Roger Dickie has promoted carbon forestry to private investors. This includes the 624 ha Greenwood Forest located near to Gisborne which is intended to generate income from the sale of carbon sufficient for investors in the forest project to have all their investment money returned within 13 years. Roger Dickie was a key player in the mid-1990s planting boom being responsible for developing around 30,000 ha of plantation forestry. His involvement in carbon forestry may therefore be significant, but this will depend partly on the ongoing integrity of the NZETS (see Boxes 8.6 and 8.7). It may be significant that after 4 years, the PFSI (see above) had resulted in the registration of only 7178 ha most of which involved pre-existing forests rather than new planting (Ministry of Agriculture and Forestry 2011: 20).

Box 8.6 Discussion Point: Good Data Is Required for a Successful Emissions Trading Scheme (ETS) (Source: de Freitas 2008)

The success of any ETS depends on how reliably greenhouse gas emissions and removals can be quantified. Put simply, you can't manage emissions unless you can measure them. New Zealand does not have a national inventory to support accurate carbon accounting of indigenous forests, pasture land and soils. Nor does it have a map of land cover at 1990, the Kyoto benchmark year. Acquiring reliable data for emissions from pastoral farming requires an understanding of numerous variables, including an animal's metabolic rate and energy requirements, the composition of its diet and feed intake, its age, breeding status and performance. The most difficult problem of all is how these things interact to determine emissions. This can be known only from an understanding of underlying processes at the farm level, and then aggregated for a national inventory and archive. New Zealand-specific figures and the means by which they are derived must stand up to international scrutiny and the audit requirements set in place by the international 'cap and trade' marketplace.

Uncertainties internationally in assembling inventories of greenhouse gases are larger than many people realise, and what figures do exist are generated from theoretical models rather than direct measurement. For example, guidelines for nitrous oxide inventory estimate were, until 2007, based entirely on methodologies using models. There are other problems. A grazing animal is not unlike a tree. Both sequester carbon over their lifetimes. For animals, the carbon captured in grass and extracted from the air gets transformed to flesh and milk. For the pastoral system as a whole there is evidence that underground storage of carbon from the roots of grass and faeces mixed into the soil constitute a net carbon sink rather than a source, as is usually assumed.

New Zealand appears to be the only country in the world considering action over their bovine populations even though many countries have far more cattle. The biggest sources of human-caused methane are the rice paddies of Asian nations.

The success of the ETS will depend of accurate accounting and reliable auditing so that there is not widespread cheating and other forms of corruption. Already there have been many claims of fraud and misrepresentation over carbon offsets and trades around the world. In the light of dodgy greenhouse gas inventories, this is not surprising. Compare carbon trading with electricity trading. In an electricity market, data on the amount of electricity bought and sold is accurate to ±0.2% every 30 min. With carbon trading, very little can be measured accurately.

Critical thing question: What risks arise for NZETS from the problems in measuring greenhouse gas emissions?

Box 8.7 Discussion Point: Are 'Carbon Forests' Likely to Be Effective in Reducing Net Emissions? (Source: de Freitas 2010)

Every tree planted removes carbon dioxide from the atmosphere and stores it in the form of wood, but the effectiveness of planting a whole forest to create a reservoir or "sink" for carbon depends on several things. The most important is the rate at which carbon is taken from the atmosphere and stored within growing trees. This varies according to tree and soil type, temperature and rainfall. Radiata pine forests can average 8 or 9 tonne of carbon per hectare per year, but this rate can be maintained for only a short period. Eventually the carbon obtained by the ageing trees by photosynthesis is exceeded by carbon lost by respiration, at which point the forest becomes a net source of CO_2. The uncertainty that carbon stays in long term storage explains why the Kyoto Protocol rules are that when trees are harvested it is assumed all carbon stored is emitted, or that trees are replanted immediately after harvest. The effectiveness of 'carbon forests' will also depend on the amount of land that is not now forested but could be used, and whether or not the land area available is sufficient. To absorb the carbon that would be emitted from a medium-sized (400 MW) gas-fired power station, more than 4,000 ha of land is required to be planted with trees. Not all land in New Zealand is capable of supporting forests and the consequences of removing agricultural land from production could be economically undesirable. Conservationists fear that private owners of native forests might be tempted to replace trees with faster-growing varieties, or that foresters will chop down existing natural forests to make way for fast-growing carbon-guzzling trees.

Critical thinking question: Should plantation forestry be accepted as a carbon sink for greenhouse gas accounting?

8.5 Energy

Energy use in New Zealand, like most modern societies, is a manifestation of consumption patterns, pricing relationships, industrial profile and technology. Of all the environmental challenges New Zealand faces, the prospect of sustainable energy in the foreseeable future is the most remote. One way of showing how New Zealand's society and economy are impacting on the environment is through energy supply and consumer energy demand. From 1997 to 2006 New Zealand's economy grew significantly with GDP per capita increasing by over 20% (Fig. 8.8). During the same period, New Zealand's total population increased by approximately 11%. As the economy and population grew, so has the demand for energy, especially energy in the form of fossil fuels.

Another way of showing how New Zealand's society and economy are impacting on the environment is through *decoupling indicators*. Decoupling refers to breaking

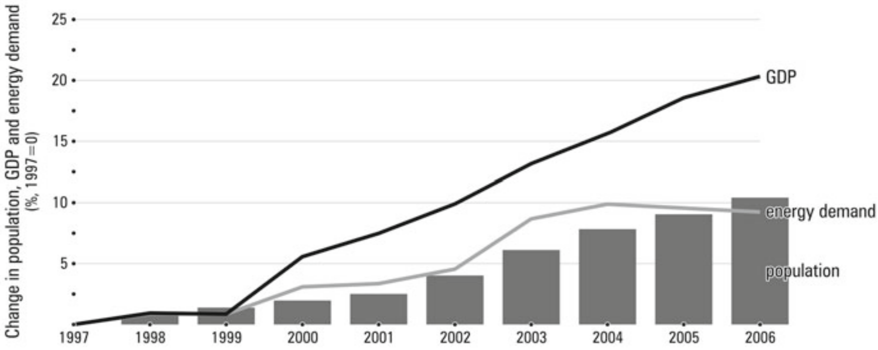

Fig. 8.8 Percentage change in population, *GDP* per capita and energy demand per capita for the period 1997–2006 (where 1997 = 0). Source: Statistics New Zealand (2008)

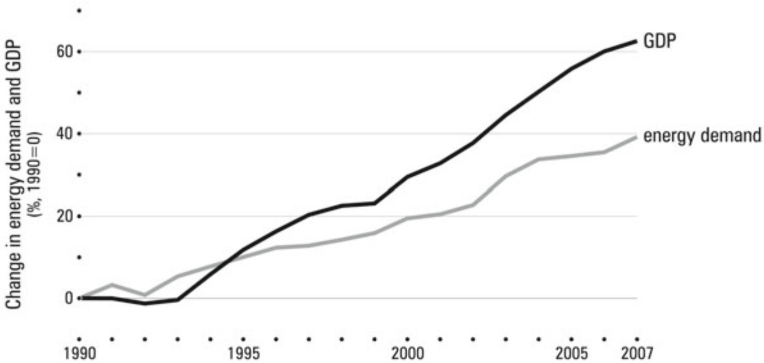

Fig. 8.9 Summary indicators, Gross Domestic Product (*GDP*) compared to consumer energy demand as measures of decoupling, 1990–2007 (percentage change since 1990). Data source: Ministry of Economic Development

connections between ‘environmental bads’ and ‘economic goods’. In particular, it refers to the relative growth rates of one or another pressure on the environment and of an economic variable to which it is causally connected. Decoupling environmental pressures from economic growth is one of the main objectives the OECD and New Zealand’s environmental management policies. Decoupling indicators measure changes over time. Decoupling occurs when the growth rate of an environmental pressure is less than that of its economic driving force (e.g. GDP) over a given period. This happened from 1990 to 2007 when demand for energy increased by 39% while GDP grew by 63% (Fig. 8.9). This showed that New Zealand’s economy was reducing its reliance on energy while sustaining growth. It occurred over a time of structural change and comparatively high economic growth and it is not clear yet that the decoupling will be sustained.

A further indicator of environmental performance in the energy sector is the proportion of total energy generated by renewable sources of supply. New Zealand’s electricity generation is mostly by renewable sources, with hydroelectric power producing about 60% of annual generation (variable depending on rainfall). Geothermal makes up around 7% with smaller contributions from other renewable sources such as biogas, wind and wood. The remainder is made up of gas and coal generation, primarily gas, but with coal making an increasing contribution. Electricity contributed 9% to New Zealand's total greenhouse gas emissions in 2007, an increase of 91% from 1990. This rise was due mostly to an increase in coal generation.

The food-miles concept has been a popular way of measuring the energy costs of getting food products to market. New Zealand's remote geographical location means that its food exports travel a large number of food miles in getting to market. The further food travels to market, the less energy efficient it is; therefore, the closer to its market that food is produced the better it is perceived to be in environmental terms. But distance travelled is only one aspect of the energy consumed in food production and distribution and while food miles continue to attract attention this is often for reasons of market protection rather than real environmental concern (see Chap. 10). As an indicator of energy efficiency, the food-miles concept is fundamentally flawed because it does not correctly reflect the total energy used in production and processing and because distance is only one consideration affecting the energy used for transport.

The carbon-footprint concept is different from food-miles in that it is a function fossil fuel consumption expressed as carbon dioxide emissions produced, taking into account production, processing and transport. Saunders et al. (2006) show that the carbon footprint was four times larger for lamb produced in Britain than for that produced in New Zealand, twice as high for dairy products and significantly higher for apples and onions. The comparison is based on current levels of agricultural activity in New Zealand. The dairy industry has expanded and there is increasing intensification and interest in developing more energy-intense forms of farming. Should this occur, the total footprint may grow and make food miles an issue.

8.5.1 Energy Policy

The legislative core in New Zealand for promoting energy efficiency, energy conservation and renewable energy in all sectors of the New Zealand economy was the Energy Efficiency and Conservation Act 2000. With the Act came the Energy Efficiency and Conservation Authority (EECA), which as noted in Chap. 3 is an independent Crown entity charged with advancing energy efficiency strategy and energy efficiency regulations. Energy efficiency is defined by the Act as "a change to energy use that results in an increase in net benefits per unit of energy". Net benefits can include quantitative effects such as increased production per unit of energy, and qualitative outcomes such as enhanced comforts (for example, warmer homes from increased insulation) and environmental benefits.

The Act requires the development of a New Zealand Energy Efficiency and Conservation Strategy (NZEECS). The NZEECS contributes to the delivery of government's energy priorities set out in the New Zealand Energy Strategy. In 2011 the New Zealand Government issued a document (Ministry of Economic Development 2010, 2011) that replaced the earlier 2007 New Zealand Energy Strategy. The NZEECS 2011 is organised around policies, objectives and targets to the end of 2015, supported by a set of means and measures all set in a matrix of priorities. The priorities are to: develop natural fuel resources (petroleum and mineral) and renewable energy; ensure secure and affordable energy; promote efficient use of energy; and promote best practice in environmental management for energy projects and reduce energy-related greenhouse gas emissions.

8.6 Conclusion

This chapter highlights that New Zealand's performance is far from exemplary as far as managing the atmospheric environment is concerned. Indicators of air quality show that the conditions in the main urban regions areas are generally poor and very little legislation is in place to control the most important source of air pollutants, namely motor vehicles. New Zealand has committed to the Kyoto Protocol, but will not meet the targets set by the treaty. All the same, how New Zealand responds to the issue of climate change now will determine the shape of the nation's future economy. The response is tied to issues of supply and use of energy and new policies related to these. The perceived threat of climate change has pushed energy to a central position. The questions that New Zealanders now face are about what amount of energy is needed for the future, the long-term effects of how energy is used, and how New Zealand manages change to more sustainable energy use.

Study Guide

End of Chapter Summary

8.1 New Zealand's climate varies from cool subtropical in the far north to cool temperate in the far south, with alpine conditions in the mountainous areas. Interaction between wind and highland give rise to none distinct climate regions.

8.2 Air temperatures in New Zealand as whole over the past 50–60 years show that there is some warming and some cooling, but there is no significant overall trend.

8.3 New Zealand's location in the strong prevailing southwesterly wind belt and its relatively small industrial economy and population means that it generally has good air quality. Air quality deteriorates in the main urban areas because very little legislation is in place to control the most important source of air pollutants, namely motor vehicles. Fine airborne particles and carbon monoxide are the main pollutants.

8.4 New Zealand produces approximately 0.2% of the world's greenhouse gas emissions and 0.12% of total world energy greenhouse gas emissions. New Zealand is not typical of developed nations in that almost half total emissions in 2009 were produced by pastoral-land activities and only around 40% from energy consumption. New Zealand will not reach its commitment made under the Kyoto Protocol to reduce its greenhouse gas emissions by 2012 to what they were in 1990.

8.5 Energy use is closely related to the level of economic activity. There is an increasing dependence on fossil fuels. This is in contrast to the pattern of energy supply for electricity generation where hydro dominates

Discussion Questions

What are some key patterns and historical trends in air pollutants in New Zealand?
What are particulates and why is their presence in the air important?
Is the concept 'food miles' useful in assessing the energy efficiency of food production?
How successful are New Zealand's energy efficiency policies?
What are 'decoupling indicators' and how are they used?
What environmental impacts can be attributed to the use of fossil fuels?
What is the Montreal Protocol and how is it different from the Kyoto Protocol?
What activities are the biggest contributors to greenhouse gas emissions in New Zealand?
How serious do you think the potential problem of global warming is for New Zealand? Why?

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Chapter 9
Urban Environment

Key Questions

- How well understood is the impact of settlement structure on the state of the environment?
- Is there evidence that urban concentration increases economic performance, potentially providing additional resources to address environmental issues?
- How has the Local Government Act 2002 and how might reforms of the Resource Management Act help urban authorities address environmental sustainability?
- How might the incidence of environmental problems and capacity to address environmental issues be affected by increasing urban density?
- What do urban residents say about their quality of life?
- Does waste management illustrate how urban populations are better able to address environmental issues than people in other parts of New Zealand?

Abstract This chapter raises questions about the impact of urbanisation on the state of the environment. The concentration of the population in urban centres and especially the Auckland region is generally seen to benefit economic development. This perception explains a lack of policy interest in redistributing population away from where it continues to concentrate. Little is known about how the incidence of and capacity to manage environmental issues might be affected by the distribution of population. In the past it has been argued that urban authorities have not had the legislative power to address environmental sustainability. The Local Government Act 2002 and possible reforms of the Resource Management Act provide more scope for councils to consider environment issues in their long term planning. The environmental values of New Zealanders continue to indicate that addressing economic well being is considered more important than improving the state of the environment. The population density of New Zealand cities is low compared with cities in Europe. There are potential environmental costs and benefits from increasing urban density.

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Key Concepts and Terms Green buildings • Long Term Council Community Plans • Population distribution • Productivity • Quality of Life • Recycling • Social capital • Spatial planning • Urban consolidation • Urban density • Waste • Zero Waste

9.1 Urban New Zealand

New Zealand is a land-based economy as judged by its dependence on primary sector exports but it has a largely urbanised population as judged from where people live. Of around 4.36 million residents in 2011, about 86% live in urban areas. This share has not changed significantly since the 1970s and official population projections anticipate that population will remain highly urbanised (Ministry of Agriculture and Forestry 2009: 26). The urbanised population is roughly equally distributed between three cities with populations of more than 300,000 each – Auckland with about 1.3 million and Wellington and Christchurch with about 386,000 each – and the rest of urban New Zealand (Statistics New Zealand 2010). The largest and among the fastest growing other urban populations are Hamilton and Tauranga, which skews the population distribution further toward concentration in the north of the North Island. The comparative geographic isolation and dependence on international trade go some of the way to explain this pattern. International air and sea transport links are critical to the economy and this concentrates activity near to major transport infrastructure. Auckland's seaport and international airport handle almost two thirds of New Zealand's imports (by value) and a third of exports (Auckland City Council 2011a, b, c: 15). Partly for access to these important gateways, Auckland is the head office location of two thirds of New Zealand's top 200 companies giving it control over much of the business activity in other parts of the country.

The unevenness of New Zealand's population distribution leaves large parts of the country thinly populated. The environmental consequences of this unequal settlement are not well understood. It relieves large parts of the country from the direct impacts of urban activity on their immediate hinterlands but creates a challenge in providing infrastructure to manage the environmental impacts of small centres particularly in respect of water treatment and waste management. For example, kerbside collection of waste for recycling is more likely to occur in a city than small town and this is important in recovering material that otherwise might enter the waste stream directly. Landfill management standards also tend to be higher in urban areas such as including methane gas extraction systems. Community waste education activities and partnerships to address specific waste problems are more easily established and maintained in the context of a large population.

Beyond infrastructure provision, the low density of population and perceived capacity of the environment to absorb pollution may have encouraged complacency such as around the use and disposal of chemicals (Szabo 1993). Population concentration can act as a form of informal regulation on business (Box 9.1). In smaller

Box 9.1 Discussion Point: Does Distance Make the Environment Grow Greener?

Two alternative propositions can be offered as to how the concentration of people in cities affects the support for conservation. To the extent that urbanisation is an outcome of increasing incomes, one expectation may be that it encourages interest in and a willingness to support environmental protection. An alternative possibility is that physical separation from wilderness areas and places where environmental pressures on the land are most critical leads people to be unaware of the true state of the environment and to be unwilling to see environmental issues given priority over economic development. The 'clean green' thesis is another interpretation of New Zealanders' views about the environment (Bührs and Bartlett 1993). It argues that confidence in the quality of the environment militates against support for a tightening of environmental controls. This proposition has gained partial support in a study which can also be interpreted as showing how physical separation matters for environmental perceptions (Hughey et al. 2004). Marine ecosystems are the aspect of the environment in which people appear to most underestimate the need for further protection which may be partly an outcome of the lesser direct contact with the ocean than the land. For example, it appears that many people have an unwarranted confidence in the state of marine fisheries and this suggests that there are particular influences shaping attitudes as well as any overall confidence in the state of the environment. It may be conservation agencies are failing to communicate information about the state of the environment or it may reflect a tendency to judge the environment by its acceptability for recreational use rather than in terms of its ecosystem integrity.

Critical thinking question: What action should conservation authorities take in response to evidence that the incidence of environmental problems is not perceived accurately by the public at large?

communities, a mix of personal familiarity with and dependence on individual employers can make people willing to accept levels of pollution that would not be tolerated in an urban environment where neighbours have no direct interest in the enterprise remaining where it is.

Having a large proportion of the population in a comparatively few centres provides opportunity to upgrade environmental infrastructure but means that this must be fitted around established populations. Public transport options are potentially more viable to service a large population than a small, dispersed population but there are difficulties modernising transport infrastructure in an already established urban environment that has been configured to rely on private transport. Road congestion is a particular problem in Auckland where the car fleet is growing at 4% a year, above the rate of population growth and where car emissions were estimated to cause the premature death of around 250 people a year (Ministry for Transport 2005).

Box 9.2 Case Study: Auckland Sustainable Cities Programme

The New Zealand Sustainable Development Programme of Action (NZSDPOA) was launched by the Government in January 2003 following the World Summit on Sustainable Development held in Johannesburg in 2002. 'Sustainable Cities' was one four NZSDPOA initiatives. It involved a pilot programme involving representatives from all the Auckland region's councils with the overarching goal of helping to develop strategies that would make New Zealand cities 'healthy, safe and attractive places where business, social and cultural life can flourish'.

The Auckland Sustainable Cities Programme was a 3-year partnership running from 2003 to 2006. Its activity was said to be guided by the definition of sustainable development in the Local Government Act 2002:

- The social, economic and cultural well-being of people and communities
- The need to maintain and enhance the quality of the environment, and
- The reasonably foreseeable needs of future generations.

It settled on six 'workstrands': transport; urban form, design and development; regional child and youth development; regional settlement strategy; sustainable communities; urban centres and economic performance.
Source: www.sustainableauckland.govt.nz

Critical thinking question: Review the report of the Auckland Sustainable Cities Programme 'Success in Sustainability' (available at the sustainable cities website) and discuss what the programme achieved and whether the programme should be revived.

The concentration of population away from New Zealand's main centres of renewable energy generation means a need for investment in energy distribution and that much of the expansion of energy generation capacity has come from non renewable sources. The particular environmental pressures facing the Auckland region partly explain its inclusion in the government's Sustainable Development Programme of Action (Box 9.2).

In the past, the Parliamentary Commissioner for the Environment (2002) has been critical of the environmental performance of New Zealand's urban populations particularly with regard to resource consumption and waste generation. A number of explanations were given for the lack of environmental initiatives among urban managers.

- The effects-based management encouraged by the Resource Management Act (see Chap. 3) had resulted in too much emphasis on managing the impacts of new development at the expense of considering the health and wellbeing of people and communities as compared with.
- Key national policy documents and reports produced during the 1990s gave little specific attention to urban issues, including the Environment 2010 Strategy (Ministry for the Environment 1994) or the State of New Zealand's Environment (Ministry for the Environment 1997).

- A lack of concern existing among urban managers, resulting in a lack of vision or effort (or both) to coordinate action among the various agencies with an interest in urban development.
- The absence of a national urban agency to research and provide guidance on urban environmental matters.

Some of the gaps identified by the Parliamentary Commissioner continue. There is still no national agency responsible for urban development that may have helped developed an information base to understand environmental issues. The 2007 state of the environment report, for example, gives no better assessment of how New Zealand's changing distribution of population affects environmental performance than did the 1997 report. As previously, the impact of urban populations is assessed mainly by examining national trends in household consumption. Give that much official information is not designed to provide insight into geographical differences a focus on national experience is understandable and something that will occur within this chapter too. It nonetheless seems important to question how the state of the environment is affected by the distribution of population. There are two aspects to this. First, understanding how alternative settlement patterns might affect environmental conditions. Some environmental impact occurs wherever people locate. In a country where the population is so unevenly spread it is relevant to consider whether this helps or hinders environmental management. Second, understanding how the particular characteristics of urban New Zealand affect the environment. Population density is low by European standards but how this affects the capacity to manage environmental issues is unclear. As well as these questions the chapter comments on local government capacity to address sustainability as this has changed since the Parliamentary Commissioner for the Environment reported on the issue. Waste management is examined as this is an environmental issue that illustrates where urban areas can have an advantage but where performance has been weak.

9.2 Cities and Economic Development

New Zealand's population concentration in its main urban region of Auckland raises the question as to whether this brings economic advantage over a more evenly distributed settlement pattern. Should urban concentration assist economic development it can be viewed as generating resources that help address environmental issues throughout New Zealand. On the other hand, if there is no economic gain from the uneven distribution of people there is potentially more reason to be concerned with the environmental consequences of the settlement pattern. Examining this question may seem unnecessary. Since the movement of people and business has been largely voluntary and based partly on individual assessments of the costs and benefits associated with different locations, it may seem self evident that crowding brings economic advantages. Leaving aside how some people have little choice but to follow where their employer asks them to go, the issue is not this simple.

Cities are built through public as well as private investment decisions. Individual businesses make decisions based around their immediate operational requirements for workers, land and services. They are typically based around consideration of a limited range of options and are strongly affected by inertia which results in existing locations being favoured without consideration of potential alternatives. Private investment decisions may not be influenced by the costs of providing infrastructure that is shared by many users. Infrastructure tends to involve large investments with a consequence that its capacity cannot be adjusted incrementally in line with changes in demand. For the country as a whole, any efficiency in providing infrastructure in a growing region can be offset by the costs of maintaining 'excess' infrastructure to service small communities. The people who migrate in search of work do not consider how their relocation affects the community that is left behind. That is not surprising since what matters is the cumulative impact of lots of individual decisions. People who move are generally not representative of the population as a whole. Places affected by outward migration in search of work can become progressively less attractive leaving behind a population for which it is harder and harder to provide employment.

The possibility that private decision making does not produce optimal outcomes explains why in older and more densely settled industrial economies such as the UK there is a strong tradition of public policy intervention to influence the location of business and people (see Perry 2010). In the past some of this concern as existed in New Zealand too, as reflected for example in relocating some government services to provincial cities. At the time of the Closer Economic Relations agreement with Australia, there was speculation that one of the benefits of increased trade with Australia would be to promote development throughout New Zealand (McDermott Associates 1983). In the event the increased openness of the New Zealand economy to international investment and trade has encouraged greater geographical concentration of economic activity. This has been accepted with little concern beyond issues associated with the challenges on maintaining health, education and other public services in rural areas.

It is not known how the performance of the New Zealand economy would be affected if were to be spread more evenly across regions and settlement sizes. The New Zealand Treasury has endorsed the view that economic development is enhanced through concentration in a large urban centre compared with the same population dispersed across small centres (New Zealand Treasury 2001: 6). This judgement is not based on an evaluation of any alternative settlement structure. Rather it is influenced by ideas that that have been developed to explain why people and business continue to concentrate in cities. These ideas deserve examination as they are limiting the willingness to open debate about encouraging alternative settlement patterns and because they can be viewed as highly speculative.

An influential interpretation of urban concentration is that big cities promote worker productivity and are better able to attract and retain skilled workers than are smaller settlements because of the cultural amenities that they can provide (Glaeser 2000). For economists supporting this claim, enhanced productivity is explained by certain features of urban labour markets that cannot be replicated in small centres (Glaeser and Maré 2001). Urban labour markets are 'thick' in the sense that they comprise more workers in most occupational groups and industries than are found in non urban labour markets. This is expected to enable a greater degree of job specialisation than in small town labour market and more scope for employers to gain from 'labour market pooling' (releasing surplus labour when not needed in the confidence that the labour skills will remain in the locality for rehiring in the future). At the same time an employee's confidence in their ability to gain employment encourages their willingness to invest in the development of their labour skills. Geographical crowding of workers is thought to allow ideas to circulate as people interact both informally, outside the workplace and through formal meetings (Knudsen et al. 2008). The result is that cities are thought to be more likely sources of innovation than smaller towns.

The amenity advantage of cities has been linked to increased living standards. Rising incomes brings a shift in expenditure towards so-called luxury goods such as those involving some degree of personalised service and live entertainment, including those enhanced by scale economies. A city, for example, is more able to sustain a diverse range of ethnic restaurants than a small town. Rising incomes are also thought to change the value of time in that the opportunity cost of non income earning time increases. This encourages people to value living in a place where least time has to be spent commuting to work and accessing out-of-work services. Being good at combining opportunities for high income work and the provision of cultural amenities underlies the thesis that successful economies increasing depend on their appeal to the 'creative class' (Florida 2005). These are the mobile professionals who are particularly sensitive to the quality of the urban environment in which they choose to work and which play a disproportionate role in driving business success.

How far New Zealand is being advantaged through such processes is unclear. Evidence from quality of life surveys suggests that Auckland is not performing as urban theorists expect. Using data from the Quality of Life surveys (Box 9.3) conducted by New Zealand's 'big cities', Auckland (referring to the former Auckland City Council area within the now amalgamated Auckland Council) is found to be the city with the lowest perceived quality of life (Morrison 2011). As noted in the study, a tendency for residents in large urban areas to have the highest levels of dissatisfaction with their quality of life mirrors international experience. The significance of this for the claim that cities enhance productivity at work is unclear. It may simply reflect that as material standards of living increase, as they tend to in big cities for those in secure employment, people increase the value attached to alternative ways of living while not necessarily allowing this to affect their commitment to their employer. The Quality of Life survey does give some basis for doubting that big cities assist social interaction, a factor that some urban theorists have linked to productivity by it assisting the sharing of ideas. The survey assesses several aspects of social capital including a sense of community and membership of social networks.

Box 9.3 Case Study: Measuring Environmental Values and Perceptions

There are several surveys that measure aspects of what New Zealanders think and feel about where they live. A 2005 New Zealand Values Survey was a comprehensive and statistically rigorous effort to gauge the values held by a representative cross section of the population (Rose et al. 2005). It was a follow on to the 1989 New Zealand Study of Values (Gold and Webster 1990). Both surveys report that environment protection is a greater priority for most respondents than ‘living standards’ and found an almost identical proportion supported an increase in government spending on environmental protection (64% versus 61% in the 2005 survey).

A ‘quality of life’ survey conducted in some of New Zealand’s largest cities gets us closer to the perceptions of urban residents. The Quality of Life project commenced in 1999 with six cities: Auckland, Christchurch, Manukau, North Shore, Waitakere and Wellington (Auckland City Council et al. 1999). The 2003 survey covered these original participants plus Hamilton and Dunedin and collectively encompassed cities that accounted for around 50% of the total population. The 2010 survey covers these participants with the addition of Hutt City, Porirua and Tauranga (AC Nielsen 2011). The Quality of Life Survey has been supported by these local authorities to help them identify and address the social wellbeing of their communities, as required by the 2002 Local Government Act. Since the 2003 survey it has been carried out biennially.

In the 2010 survey, the majority of urban residents rate their quality of life as extremely good (29%) or good (63%). After family, financial stability, health and work are the three most frequently cited contributors to people’s quality of life judgement. The share reporting positively on their quality of life is highest for those with a household income of $100,001 or more (98%) and is lowest for respondents in a household with an income of $20,000 or less (81%) and a household income of $20,001 to $40,000 (86%). All income groups have a similar rating of the importance of feeling a sense of community, but those most likely to feel a sense of community with others in their local neighbourhood have a household income of $20,001–$40,000 (66% compared to 61% for those with household incomes above $100,000). Within the Auckland Council area, people living in Waiheke and Great Barrier Islands are the most likely to say that they feel a sense of community (88% compared to 61% for all Auckland) and the least likely to rely on work or school for their social networks.

Critical thinking question: Should evidence that the perceived quality of life increases with income encourage governments to prioritise economic growth over environmental management?

In the 2010 survey, more than two thirds (71%) of urban residents agree it is important to feel a sense of community whereas less than two thirds (60%) agree that they do (AC Nielsen 2011). Rather than neighbours or social contacts, most people's networks comprise people from work or school. Analysing such data from the 2004 survey, Morrison (2011) finds that the relationship between the extent to which people experience a sense of community and the overall satisfaction with their quality of life is complex. In some places it appears to have a big bearing on personal well-being, in other cities it seems to have little influence. In the case of Auckland, some unidentified aspects of the city depress the levels of well-being reported by residents beyond that which can be accounted for by the relative absence of a sense of community. Overall it is suggested that the Quality of Life evidence confirms the popular perception that the social environment improves south of Auckland. People it seems have more time for each other and exhibit higher levels of social capital when there are fewer of them.

There is evidence that business productivity is higher in Auckland than elsewhere (Maré 2008). This may be taken to show that it is not the experience of the population as a whole that matters so much as that of the professionals that are engaged in creative occupations and with most capacity to drive innovation. Such an argument informed the development of the creative class thesis which, as noted above has been encouraging belief in the importance of making cities attractive to mobile professionals (see Perry 2011). How far resident perceptions of well being are disconnected from a city's economic performance is unclear but some questioning of the productivity evidence is nonetheless justified.

The Ministry for the Environment (2010a: viii) refers to an average 45% increase in productivity in Auckland compared with the rest of New Zealand as evidence of the city's competitiveness and importance of maintaining its growth. This interpretation of the productivity statistics fundamentally misinterprets what they show. The productivity of places across an economy varies primarily according to the distribution of economic activity (Fothergill 2005). Auckland attracts activities with high productivity such as the headquarters of banks whereas small towns are where small branches of the bank locate. The importance of Auckland cannot, therefore be judged by comparing the productivity of business in different locations as this mainly shows where particular types of establishment locate. Knowing how a place affects the productivity of the individual establishment is of interest. This is hard to calculate as it requires comparison of how productive the headquarters is in Auckland versus how productive it might be were it to be located in another place. Asking what determines the size of the headquarters is another way to think of this issue. If it is assumed that in some way Auckland is a highly productive location, would this cause the headquarters to grow? Or is the size of the headquarters determined primarily by the state of the New Zealand economy as a whole and the activity going on in branches around the country? There is presumably some capacity for the efficiency of the headquarters to feedback on the ability of the bank to grow, as for example if resource savings are channelled into marketing. In today's world as well it may be that if Auckland is a particularly productive place some management activity might be retained there that otherwise would take place in Sydney or Melbourne or some other overseas city. In this regard evidence from the Quality of Life survey may be of less significance than international comparisons of the quality of life offered by cities around the world (Box 9.4).

Box 9.4 Discussion Point: International Quality of Life Comparisons (Source: Auckland City Council 2011a)

The Mercer 'Quality of Living Survey' is an internationally cited comparison of perceptions of liveability. It asks questions about the political and social environment, the economic environment, health and sanitation, schools and education, public services, transportation, housing, the natural environment and recreation. Out of the 420 cities surveyed in 2010, the former Auckland City (4th equal with Vancouver) and Wellington (7th) ranked among the most liveable cities in the world. Results in the survey are presented against a base score of 100 for New York with Mercer's top 25 cities varying between a top score of 108 (Vienna) and Seattle (100).

Critical thinking question: What does the similar high ranking of Auckland and Wellington suggest about what the survey is measuring?

There is reason to be concerned with how Auckland affects business performance but productivity data are not revealing that Auckland itself is contributing to New Zealand's economic performance; they primarily report what types of activity are located there. There may be some internationally footloose activity than locates in Auckland or nowhere else in New Zealand and there are some services that operate more efficiently when they have a large population to serve but primarily the region's economy should be viewed as a creation of the economy as a whole. Moreover, ideas about the productivity impact of cities have been developed in the context of much larger places than Auckland.

Auckland is not a large city by world standards and it may require a much larger concentration of people to generate the kind of labour market processes that have been speculated upon. Auckland still remains a comparatively small labour market in which around a fifth of employment is provided by 100 employers that operate in other parts of New Zealand too (Perry 2002). These big employers have tended to centralise more of their activity in Auckland, partly as improvements in information technology and communications have removed the need for management in the regions. With the option of running all operations in New Zealand from a single location, it is logical to place control functions in the region which is also the largest market. In contrast when it comes to people Auckland has had the highest net loss of people moving out to other parts of New Zealand of any region (Auckland City Council 2011a: 13; Perry and Hayward 2003). International migration has contributed disproportionately to the growth of the Auckland region (Ministry of Economic Development et al. 2011; Newell 2002). In 2006, 35% of the region's residents were born overseas or more than double the share of the rest of New Zealand (Auckland City Council 2011a: 13). In the context of New Zealand needing to recruit labour skills from overseas, this may indicate an importance to urban concentration but otherwise there are reasons to be open to the possibility that alternative settlement patterns may be of equal or even greater economic value.

Whatever the explanation for the present distribution, it is likely that population will continue to concentrate in the Auckland region and elsewhere in the upper North Island. Official projections indicate that 60% of New Zealand's population growth from 2006 to 2031 will be in the Auckland region (Statistics New Zealand 2010). This will take the region's share of national population to close to 40%. In contrast, 73 territorial authority areas are expected to experience a decline in population, mainly already sparsely populated areas. Questions can be asked as to how the state of the environment will be affected by this redistribution and how this would compare with other population distributions. Providing authoritative answers is not yet possible.

9.3 Local Government Planning

Up to 2002, urban authorities were able to argue that promoting sustainable development was outside their core statutory responsibilities (Parliamentary Commissioner for the Environment 2002). The Local Government Act 2002 changed the situation as it requires local authorities to take a 'sustainable development' approach to promoting the social, economic, environmental and cultural well being of their communities. The Act interprets sustainable development as taking into account the: (i) social, economic and cultural wellbeing of people and communities; (ii) the need to maintain and enhance the quality of the environment; and (iii) the reasonably foreseeable needs of future generations. It has been argued that this interpretation does not require local government to move beyond its traditional focus on economic prosperity nor to pursue wellbeing within ecological constraints (Taylor 2005). It does require that councils produce a Long Term Council Community Plan (LTCCP) in consultation with the communities that they represent. These plans are to explain the activities a council proposes to engage in, the reasons for engaging in those activities and how the activities fit together to achieve outcomes desired by their community. An analysis of the community outcomes included in the drafts of the first wave of LTCCPs found that the economy and the natural environment were the two most frequently included outcome areas (Department of Internal Affairs 2006).

A subsequent review of the treatment of sustainable development in LTCCPs found that they were of modest significance in assisting councils develop long term strategies for their localities (Holdsworth 2007). The review noted, for example, that there was little discussion of sustainable development in terms of consideration of the reasonably foreseeable needs of future generations. Rather the time review under consideration was frequently no more than 'the next few years' (Holdsworth 2007: 15). The review was based on a sampling of plans produced by councils of varying size. Improvements were observed among middle as well as large councils but overall no impression is given that larger authorities are addressing sustainability more rigorously than medium-sized ones.

As noted in Chap. 3, the Ministry of the Environment (2010a, b) has examined how the urban planning framework can be improved. This review is motivated primarily by a belief that the existing regime is hampering economic development. A particular concern of the review, for example is that the Resource Management Act is more attuned to assessing the effects of development on the natural environment than on promoting high standards of urban design and the integration of new development with infrastructure planning. Proposals envisage reform that will for example make it easier to designate land for future infrastructure development and that would speed up land acquisition for public works partly by enabling acquiring authorities to be more flexible in the determining the compensation paid than at present. Of potential significance for environmental management is a strengthened role for spatial planning. The Resource Management Act requires the preparation of Regional Policy Statements that identify resource management issues of the region and offer direction as to how issues should be managed by outlining objectives, policies and methods. Under review is the possibility of enhancing these documents by developing them into 'spatial plans'. The thinking here is partly influenced by the power given the amalgamated Auckland Council to prepare a plan for the region that provides an overarching vision for Auckland, guides growth management, aligns land use and infrastructure investment and enables the simplification of other planning documents (Ministry for the Environment 2010a: 21).

The Greater Christchurch Urban Development Strategy is given as an example of the potential benefits of introducing regional spatial plans (Ministry for the Environment 2010a: 28). This strategy addresses how a projected population growth of 75,000 households could be best accommodated having regard, among other issues to the desirability of minimising the loss of high quality open space, the need for travel to work and avoiding traffic congestion. As implementation of the plan was to be through the established channels provided by the Resource Management Act and the Local Government Act, the main innovation was the extent of inter-authority cooperation in producing the strategy. To the extent it achieves this outcome, spatial planning may help consideration of environmental impacts from land use change.

9.4 Urban Structure and Sustainability

New Zealand cities have a population density lower than cities in Europe but not unusually so for cities in other countries with low population density. Indeed with a population density of around 2,200 people/km^2, Auckland is not far below Copenhagen (2,400) and substantially higher than Melbourne (1,600) and Brisbane (900) (Auckland City Council 2011a: 15). Moreover the trend in Auckland is for more of the population to concentrate in the central parts of the city and for the proportion of new housing developments that are medium density and apartments to grow. Auckland's economic planners believe that the trend for density to increase will support improvements in productivity and mainly for this reason it is a trend that they wish to encourage (Auckland City Council 2011b).

Changes in morphology have potential to reduce the environmental impacts of urban populations but it appears that neither a shift to higher density or low density is certain to do this. Low density urban sprawl is frequently viewed as the worst kind of urban structure (Haughton and Hunter 1994: 84). Part of the concern arises from the belief that it results in social isolation and part from concern that when associated with privately-owned houses the lack of social and economic diversity encourages isolation from wider society. From an environmental perspective the concerns include the loss of agriculture land and increased energy usage and air pollution as a result of the tendency for low density environments to be based on private transport. A strong relationship was long ago demonstrated to exist between urban population density and petrol consumption per capita, with Hong Kong having about 3% of the consumption of Houston (Newman and Kenworthy 1989). Car-based housing environments are associated with a high proportion of impervious surfaces that result in the runoff of rainwater carrying oil and other pollutants. Recycling rates can drop compared with dense urban environments because of the additional collection effort. Energy consumption can increase in single-storey, detached housing because of poor thermal qualities compared with more compact housing forms while land devoted to gardens is viewed as a cause of increased water consumption.

On the positive side, low density allows people to use the additional space in ways that bring environmental advantage. This may be the use of garden space for composting food waste, installation of solar panels and the collection of rainwater. Gardens reduce the runoff of rainwater, provide wildlife habitat and it is suggested can help promote affinity with nature (Haughton and Hunter 1994). In hot climates, gardens can save energy by providing natural shading and trees can be viewed as helpful for carbon storage.

The balance of these advantages or disadvantages will depend on local circumstances. The extent to which low density environments generate greater use of private transport, for example, depends partly on the extent to which land uses are separated in ways that give rise to the need to travel for day-to-day activities. The extent to which suburban gardens provide a home for nature depends on the adaptability of wildlife and willingness of gardeners to accommodate their presence. Investment in solar panels may be affected by the extent to which conventional energy sources are exposed to carbon pricing, climatic conditions and the suitability of building designs to accommodate panels. Whether garden consumption of water is a concern will vary with the availability of freshwater and the type of garden environment that typically exists. It is also important to measure the net outcome of different living arrangements for the city as a whole. Rainwater collection may be viable option for households but may not lessen the need for water supply infrastructure to service facilities that must have security of supply. Encouraging home composting may be beneficial but the use of centralised composting facilities may make higher quality compost and distribute to the most productive users.

As a consequence it can be more appropriate to consider the opportunities for raising the environmental performance of all types of housing environment rather than enforcing conformity to one environmental best solution. An Australian study of the comparative environmental merits of 'traditional' and 'modern' suburbs in part of New South Wales shows some of the grounds for maintaining diversity (Ghosh and Head 2009) (Table 9.1). Modern are shown to have a potential advantage

Table 9.1 Traditional and modern housing environments

Suburb type	Attributes	Environmental performance
Traditional – older residential development, around 10 dwellings per hectare	Large plots, generous rear & front garden, modest detached dwelling	Roof collection can supply 63% of household water consumption, but with potential for additional on-site storage. For carbon storage, 23.5% of site has tree canopy, but storage reduced by age and type of tree. An area of 95 m^2 available for garden food production. Energy savings from greater use of outside clothes drying
Modern – typical new Australian suburb, around 15 dwellings per hectare	Contemporary 1 or 2 storey dwelling, moderate plots, landscaped rear & front garden spaces including modern amenities	Roof collection can supply 135% of household water consumption. For carbon storage, 5.5% site has tree canopy, but age and variety of tree has potential to enhance storage. An area of 48 m^2 available for garden food production

Source: Ghosh and Head (2009)

in their large roof areas relative to traditional if this is put to rainwater collection but this potential would depend on the availability and acceptability of storage capacity that will fit on house plots that are smaller and more built up than traditional. The weakness of modern suburbs is the larger proportion of land in impermeable surfaces although this could channel water into storage. The use of outdoor areas for clothes drying compared with the use of internal clothes dryers offers opportunity for major gains in modern suburbs. Selecting garden trees for carbon capture and managing them for this purpose can enhance the contribution of small gardens. In these ways there is scope to retrofit modern suburbs to bring up their environmental performance. For the traditional suburb the scope for enhancement is in recognising and protecting contiguous tree cover to create open space green corridors and in promoting food production in gardens. The researchers do, however, admit that the environmental gain of home food production needs to be considered against the watering, fertiliser use, transport requirements and labour required as well as the incompatibility with tree cover (Ghosh and Head 2009: 342). The time and labour involved in running a sustainable household was not part of their study and it is acknowledged that housing environments that do not involve behaviour changes to deliver environmental gains may be the most viable.

As well as urban density, the environmental impacts of urbanisation are partly mediated by household composition. Two important aspects of household composition are the ratio of people to households and the share of single person households. From 1992 to 2008, the population of New Zealand increased by 21% while the number of households increased by 27%; from 1991 to 2006 the share of single person households increased by 14% (Ministry for the Environment 2009). The consequent sharp drop in average household size in the context of the economy's accelerated growth after the mid 1990s has been seen to amount to a mini social revolution (Sundakov 2005). As well as social change, the creation of additional households has important environmental outcomes because each household generates base resource demands that do not vary with the number of occupants. For example, two separate one-person households may each utilise a range of household appliances that would typically be shared in a two-person household. The sudden drop in household size suggests that there was pent up demand for new household formation that was liberated by an increase in incomes and confidence in the future. Official projections envisage that by 2021 the share of households is projected to rise to 26.5% and the average household size to drop to 2.4 persons from 2.9 in 1999.

The process through which high density is achieved must also be considered. Building a high density environment from the outset gives more scope to optimise its environmental performance than where environments are retro fitted for high density. Urban consolidation policies that promote more house building within existing urban areas can appear to offer savings in infrastructure costs and increase the viability of public transport options compared with allowing low density expansion of the urban fringe. How far they achieve this has been the subject of much discussion in Australia where urban consolidation became a controversial issue in the 1990s (see Troy 1992). In the context of Australian cities, urban consolidation has been pursued through infill on non-developed land, subdivision of existing house plots and allowing higher density housing in areas where land use plans have previously kept housing density comparatively low (Haughton and Hunter 1994: 89–90). For existing urban residents a move to higher density can be associated with a loss of amenity, although some may be compensated through higher land values. How far there is a cost advantage in providing infrastructure in higher density areas than low density suburbs will depend on local circumstances. The extent of spare capacity in the existing infrastructure serving the locality where density is to increase and the extent to which rebuilding of the housing stock is required will have a significant bearing on the relative costs of intensifying the urban core versus allowing the urban area to expand outwards at low density (Roseth 1991; Searle 1991; Unwin and Searle 1991; Troy 1992).

The relative costs and benefits of urban consolidation in New Zealand are not well understood. The review of urban infrastructure planning by the Ministry for the Environment (2010a) does not discuss the issue except in so far that it questions the setting of metropolitan urban limits. The review emphasises how little is known about the impact of putting limits on the availability of land to accommodate urban growth outwards from the existing centre. Accusations that restricting land supply reduces the availability of low cost housing appears to be the main issue causing the Ministry to suggest that the present ways that limits are set may be too restrictive. This concern is voiced by the property development industry and those who favour a 'free market' in land development (for example see commentary by Owen McShane in the National Business Review). Research indicates that the relationship between land supply and house prices is affected by many factors other than planning controls (Grimes 2007). Subsequent to the 2008 global financial crisis it has become clearer that house prices are substantially affected by the supply of finance to fund housing development and purchase (Tett 2009). The boom in house prices has to be understood in this context as well as any issues arising from the extent to which land use zoning may restrict the area of land available for new housing. Nonetheless the Ministry for the Environment (Ministry for the Environment 2010a: 22) is concerned that metropolitan urban limits are not sufficiently justified simply by the desire to protect rural and coastal environments.

9.4.1 Green Buildings

Irrespective of density, new housing is one of the three areas of private expenditure (others are food and beverages and private transport) with the greatest environmental impacts when their full life cycle is considered (European Environment Agency 2007). The Ministry for the Environment has given some attention to encouraging new housing concepts designed with sustainability in mind (Jenkin and Pedersen 2009). To date the 'Earthsong' housing development in Waitakere, Auckland is the major example of ecological principles being built into new housing development (Box 9.5). The idea of 'green' office buildings has gained attention assisted by the New Zealand Green Building Council (NZGBC) based upon similar bodies now existing in North America and Europe. Interest in green office buildings reflects how for many service organisations the buildings occupied put limits on their ability to demonstrate concern for the environment. Purpose-designed to minimise environmental impacts, modern buildings can operate with greater efficiencies in energy usage than previous generations of buildings (Oldfield et al. 2009).

Box 9.5 Case Study: Waitakere, New Zealand's Eco City (Source: Pratt and Lowndes (2005), www.earthsong.org.nz)

The former Waitakere City, now part of the Auckland Council, was held up as New Zealand's leader in sustainability initiatives. This can be attributed partly to its location straddling Auckland's continuous urban sprawl and an extensive area of surviving natural vegetation (the Waitakere Ranges) that borders a series of west coast beaches used for comparatively low intensity recreation. The reputation for environmental leadership comes partly from it being first to prepare a strategic plan, styled a 'greenprint' that combined social, environmental and economic goals. Other initiatives have been community involvement in seeking solutions to sustainability issues including a bi-annual quality of life report, applying 'soft' engineering solutions such as planting natural vegetation to control stormwater in place of physical infrastructure, reduces in solid waste to landfill, supporting the development of a new hospital and a housing project 'Earthsong' that incorporate ecodesign principles.

(continued)

Box 9.5 (continued)

The founders of Earthsong had the vision of building a neighbourhood that was as socially and environmentally sustainable as possible based on the principles of permaculture. As well as providing a home for its permanent residents the aim was to serve as a model of a socially and environmentally sustainable community. Earthsong residents actively participate in the design and operation of their own neighbourhoods following the concept of 'cohousing', a form of collaborative housing conceived in Denmark in the early 1970s. The physical design of a cohousing community encourages both social contact and individual space. Cars are kept at the edge of the site to create a pedestrian friendly neighbourhood designed for casual interaction and safe play for children. Private homes contain all the features of conventional homes, but residents also have access to extensive common facilities such as gardens, outdoor sitting and play areas, workshop and a social centre known as the Common House.

Critical thinking question: What aspects of Waitakere's community and location encouraged it to give priority to environmental management? Can it provide a model for other parts of New Zealand?

To be considered 'green', buildings are expected to be designed with attention to 'increasing the efficiency with which buildings and their sites use energy, water and materials, and reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal – the complete building life cycle' (Cryer et al. 2006). The NZGBC certifies buildings making such claims using a rating system developed in the USA and which identifies 6 grades according to the extent to which environmentally advantageous features are incorporated in the building. When constructed, the green design features incorporated in the 6-Star Christchurch Civic building (the highest grading awarded) included (Christchurch city Council 2011):

- using biogas to generate electricity for the building;
- harvesting rain water for toilets, landscape irrigation and water features;
- installing energy-efficient light fittings with automatic daylight dimming;
- using solar energy to heat water within the building;
- sensor-activated rather than permanently running escalators;
- lifts that have capacity for power generation when descending;
- a double-skinned facade to reduce the demand for heating and cooling within the building.

The design features incorporated into the Christchurch Civic building mean that it reduces its use of electricity supplied through the national grid and uses rainwater to reduce its use of freshwater. The building's 'greenness' was also a result of it incorporating an existing building, for which energy savings were imputed and by the effort to ensure that as much building waste as possible was recycled rather than being sent to landfill. The on-site electricity generation makes use of biogas collected from the council's landfill. As this power generation might otherwise be fed into the national grid or utilised close to the landfill, its use to assist a green building designation is not entirely a net gain for the environment. Similarly, heritage protection partly motivates the retention of parts of older buildings in new developments.

Green building certification is based on a flexible system that allows points to be obtained from a range of design aspects that have potential to be a net environmental gain. This allows building developers and occupants to achieve green status on the basis of local opportunities. A more rigorous system of certification would score the extent to which individual buildings change the environmental impact of the city in which it is located. Another source of doubt surrounds the extent to which energy savings envisaged when a building is designed are achieved in practice. Research in New Zealand suggests that among a sample of green buildings few (15%) perform within the range of energy savings predicted at the initial certification of the building (Gabe 2010). This may arise because patterns of occupancy and usage vary from those on which the power savings predictions were made. Green building certification requires periodic renewal and so such discrepancies have potential to be corrected. As well it should not be overlooked that depending on the design features that are emphasised there can be benefits for the people working in the building (Box 9.6).

Box 9.6 Benefits of Ecodesign at Waitakere Central (Source: Brown and Legg 2011)

The former Waitakere City Council's main office 'Waitakere Central' was designed with a range of green building features. The most effective are considered to be those that optimise the interaction between the occupants of the building and between the office workers and the immediate neighbourhood. The office is easily accessible and benefits from its location and proximity to public transport. It contributes to the neighbourhood through its building of a new pedestrian crossing over the railway line and increasing foot traffic through the town centre. Waitakere Central is separate from other council buildings as part of a plan to reinvigorate the locality by spreading employment around the locality (Henderson).

The building has a wide, gently sloping, well-ventilated, light-filled stairwell that is said to encourage socialisation and walking from floor to floor (lifts are deliberately not in prominent places within the building). Printing machines require activation by a key card requiring that people walk to them rather than sending jobs to the printer from their desk. This need for walking to a machine encourages movement around the office and is believed to save on toner and paper as nonessential items are less likely to be printed. Unprinted items are

(continued)

Box 9.6 (continued)

deleted after an hour. The building has comparatively few car parking spaces (reducing each year) that are made available only to staff who join a carpool. Office workers have access to subsidised public transport and enclosed cycle parking and showers. It is said that the benefits of these aspects of the design derive more from the way they accommodate people and their needs and also how they influence people's behaviour toward more positive environmental, social, and economic outcomes. The owners of such buildings can be expected to benefit from ease of attracting and retaining staff, fewer injuries and time off, reduced consumption of resources and materials, reduced waste, reduced operating costs, and community goodwill.

Critical thinking question: What impact might the creation of the Auckland Council have had on the environmental advantages of Waitakere Central?

9.5 Waste

The Parliamentary Commissioner for the Environment (2002) identified waste management along with drinking water quality as environmental issues that urban areas should see improve at a faster rate than the rest of New Zealand. Waste is any material that is unwanted and is discarded. It can be solid (such as paper, plastic, metals, food, wood, concrete or soil) or liquid from kitchens, bathrooms, laundries and factories, or it can be gas or chemicals. Waste is frequently seen to exemplify much that is wrong with current patterns of production and consumption (Simpson 1990). Zero Waste New Zealand is part of an international movement that aims to get city and district councils to commit to the target of zero waste to landfill by a specific date. By 2005, 49 (67%) of New Zealand Councils had committed their communities to zero waste to landfill most with targets of 2015. Zero Waste New Zealand sees waste elimination as achievable through a combination of 'end-of-pipe' responses based on recycling and recovery and to the adoption of design principles that extend product life and facilitate the diversion of material out of waste streams. The creation of a value-added resource recovery industry and sustainable job creation are among the benefits that the Zero Waste initiative also targets.

The eradication of waste has been presented as a need for cities to mimic the way natural ecosystems operate (Haughton and Hunter 1994: 208). The interpretation is that balanced ecosystems operate with minimal loss of resources. Another view is that natural ecosystems are highly inefficient and are distinguished partly by their production of waste in the form, for example, of excessive numbers of seeds and young animals compared with those that grow to maturity (McDonough and Braungart 2006). The important attribute of a natural ecosystem is that waste degenerates into life-supporting material not that there is no waste. Applied to economic activity, this perspective holds that waste is a problem only where it is of a form that cannot be discarded and left to biodegrade naturally or constitutes material that cannot be immediately reused. Whether zero waste is the optimum policy goal can, therefore, be debated but there is little doubt that there are many waste management problems that currently need addressing. The universal waste issue is how to manage it so it does minimal environmental damage.

Household waste accounts for around 40% of the solid waste sent to landfills each year dividing almost equally between that coming from kerbside rubbish collection and that delivered direct to landfills (Ministry for the Environment 2006b). This amounts to annual per capita disposal of around 310 kg. Another 40% of landfill waste is 'cleanfill' that includes such things as concrete, rubble, plasterboard, wood, steel, brick and glass.

A New Zealand Waste Strategy was launched in March 2002 with the aim of trying to reduce the amount of waste per unit of economic output, in other words to break the link between economic development and the creation of waste (Ministry for the Environment and Local Government New Zealand 2002). It envisaged replacing an 'end of pipe' perspective focused on disposal with a 'cyclical' perspective that designs out waste and maximises the reuse and recycling of resources. This made the strategy more ambitious than previous government waste management initiatives. Under the Local Government Amendment Act 1996, local authorities were already required to prepare waste management plans and since 1992 the Ministry for the Environment had been negotiating waste reduction targets with business sectors and encouraging voluntary initiatives.

The strategy was developed in a partnership formed in May 2000 between the Ministry for the Environment and Local Government New Zealand. A Working Group on Waste Minimisation and Management advised on the strategy's content and direction. The strategy released in 2002 outlined a vision, goals and targets consistent with the commitment that was obtained among national and local organisations to address waste management. It identified actions with respect to developing a sound legislative basis for waste minimisation and management, developing efficient pricing policies, implementing high environmental standards and making more efficient use of materials. The strategy promoted 'green purchasing' and noted that since government consumption comprised more than a fifth of GDP it ought to be the leader in including environmental criteria in purchasing decisions.

By 2010 the Ministry reported progress in the access to recycling, regulation of landfill and waste disposal (Ministry for the Environment 2010c). Significant early gains were a rationalisation in the number of landfill sites from 327 in 1995 to 90 by 2005 most of which incorporate engineering and drainage control to minimise risks of pollutant seepage (Ministry for the Environment 2006b). A growth in the volume of material collected for recycling is a further outcome of the increased efforts to manage waste, although this is mainly restricted to paper, glass, plastic and metals. By 2004, 75% of local councils provided kerbside collection of recyclable materials compared with 20% in 1996 (OECD 2007). In addition to the efforts of councils to facilitate the collection of material for recycling, a voluntary 'Packaging Accord' started in 1996 had some impact in encouraging suppliers and distributors of consumer

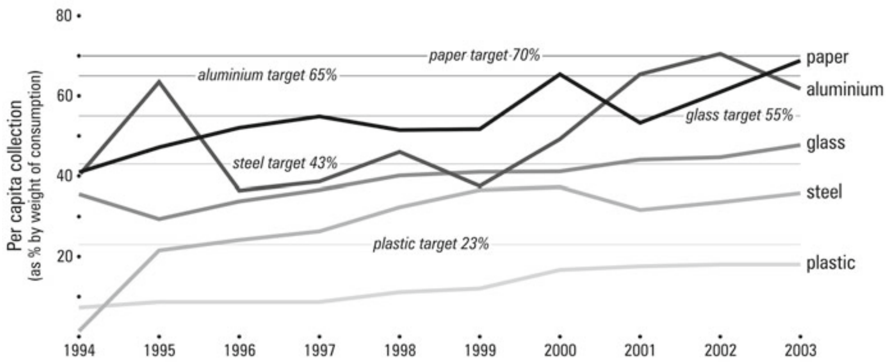

Fig. 9.1 New Zealand's packaging recovery trends and targets. Source: Ministry for the Environment (2006a)

goods to reduce their use of packaging and ensure more used packaging was collected for recycling (see Chap. 2). There is evidence of some improvement in managing solid waste over the past decade (Fig. 9.1). Nonetheless the OECD (2007) remained critical of New Zealand's efforts to manage waste. It pointed to a lack of coherent management with legislation dealing largely with the disposal of waste, while recycling, recovery and packaging minimisation initiatives are dealt with solely on a voluntary basis. Subsequently the Waste Minimisation Act 2008 included the introduction of a waste disposal levy that supported the OECD's recommendation for more use of economic instruments to manage waste. Following the 2010 review of the Waste Strategy, the original target of achieving 'zero waste' was replaced by the goals of reducing harm and improving efficiency, which are seen to easier to demonstrate progress on than is zero waste.

A continuing challenge is the economic viability of recycling for a range of materials. Some of the bulkiest and most problematic types of waste such as electronic goods are still disposed of through landfills and the illegal dumping of end-of-life vehicles continues to be a problem (Zero Waste New Zealand Trust 2005). Conversion to digital television has necessitated industry attention as it threatened a massive dumping of older television sets. The small size of the local market for recycled material is aggravated by New Zealand's isolation from the larger world markets for waste makes even well established recycling processes such as those for glass precarious and vulnerable to collapse (OECD 2007). For example, the disposal of used tyres has become a significant problem with increasing rates of car ownership and the closure of New Zealand's main tyre reprocessing firm (Ministry for Transport 2005). Reprocessing requires a large scale of operation, which in New Zealand means a nationwide retrieval system or payment for receiving tyres. The Ministry of Environment commenced a scheme that has since been taken over by the Motor Trade Association under the name Tyre Track. It assists tyre companies collect end-of-life tyres and redistribute them to users and processors and is one of a number of waste exchange programmes that aim to match up businesses that generate, recycle and reuse waste.

The collection and sorting of household material for recycling are major economic issues too. A challenge for waste recycling is sustaining citizen commitment and cooperation (Nickerson and Moray 1995). Education and advertising campaigns are their own cannot be certain of bringing lasting change. In large urban areas it is possible to collect large quantities of material through regular kerbside services that can be partly mechanized through the use of ‘wheelie bins’ combined with automated sorting processes. This approach makes compliance easy for people but it relies on technology to make it economic to sort the waste into different materials. This is the approach being taken in Auckland although it may not match the quality of recycled material that can be obtained through small scale community-based recycling schemes of the sort that once existed on Waiheke Island (Box 9.7).

Box 9.7 Case Study: Community Versus Technology-Based Recycling Options (Source: Brown and Legg 2009)

The collection of household waste for recycling needs to balance the effort required to sort material post collection with the effort required of households to sort waste prior to collection. Post collection sorting is expensive but requiring households to do the sorting risks reducing the compliance with recycling schemes and still requires checking to ensure that the collected waste is of the form expected. As sorting is largely a manual task, particularly when differentiating types of plastic and excluding composite materials, it is costly relative to the value of the recovered material and involves work that is unpleasant and of low status. Where there is too much impurity, waste is sent to landfill including the potentially recoverable material. Low grade recycled waste may in practice end up in landfills or be sold for recycling without this occurring (some may become a fuel source).

In 2009, the former Auckland City Council opted for a technological solution. In contracted the Transpacific Industries Group to manage a recycling system involving an advanced materials recovery facility (sorting plant) located in Onehunga. This plant is designed to handle co-mingled recycled waste so that households are simply required to sort recyclable waste from their other household waste. The co-mingled recyclables are collected from the kerbside. The Onehunga plant includes automated sensing to distinguish grades of plastic as well as more traditional conveyor and vibration systems to sort waste into different materials. The claims are that the plant can handle high volumes of waste and produce a high grade of sorted material that is of comparatively high value and therefore marketable to the recycling industry.

(continued)

Box 9.7 (continued)

The decision to go with Transpacific Industries was resisted by members of a community-based recycling scheme on Waiheke Island. It operated a low tech approach to recycling based on the willingness of residents to sort recyclable material prior to collection and a largely manual sorting process. This system worked partly because the waste sorting facility was operated as a community employment scheme and with a vision about the environmental importance of managing waste. It claimed that the recycled waste it sorted was of higher quality than that possible with a technological sorting process, making its waste of higher commercial value.

Critical thinking question: What are the advantages and disadvantages of minimising the effort required of households to recycle waste?

For the present the new Auckland Council has acknowledged that the region has underperformed when it comes to waste management (Auckland City Council 2011c). It suggests that the problem of controlling waste is partly an outcome of the loss of ownership and control over most refuse transfer stations and landfills with private operators not being bound by the obligations of the waste Minimisation Act. This has left it with little control or influence over most day-to-day decisions on the handling of the entire waste stream to landfill.

9.6 Conclusion

The concentration of population in Auckland and other cities in the upper North Island creates an uneven distribution of settlement. Most comment on this pattern assumes that it responds to and builds economic advantages, particularly with respect to the way that business productivity is thought to be highest in big cities. There are reasons to question such claims and the lack of policy interest in promoting a redistribution of population although the environmental consequences of the continued concentration of population are not well understood and may even favour leaving large parts of the country lightly settled. Within Auckland there is interest in increasing urban density. It is doubtful that this can be justified by any gain in business productivity. Quality of life and social capital measures suggest that human interaction is stronger in smaller cities than Auckland. A possibility with urban concentration is that economies of scale facilitate the use of environmental management technology. Waste management has improved in urban areas but significant problems remain in both the volume of waste being generated and in ensuring that waste collected for recycling is processed into marketable products.

Study Guide

End of Chapter Summary

9.1 The distribution of New Zealand's population is concentrated in urban areas and within urban areas within three cities that account for around half the total urban population. The Parliamentary Commissioner for the Environment has been critical of the environmental performance of New Zealand's urban populations particularly with regard to resource consumption and waste generation.

9.2 Business productivity is higher in Auckland than the rest of New Zealand and there are claims that this indicates the economic advantage of big cities. Evidence from Quality of Life surveys suggests that social capital is stronger in smaller cities and productivity differences can be explained by the distribution of activities with high productivity.

9.3 Prior to 2002 urban authorities did not have explicit statutory responsibility to address environmental sustainability. The Local Government Act 2002 now requires local authorities to address 'sustainable development' and to produce Long Term Council Community Plans (LTCCP).

9.4 New Zealand cities are of low density compared with cities in Europe but they have density typical of cities in countries with low overall population density. There can be environmental advantages and disadvantages to promoting an increase in urban density.

9.5 Waste management has been improving particularly with respect to landfills and the volume of material collected for recycling. Official New Zealand policy no longer encourages a zero waste target and is concentrating on reducing harm from waste and increasing product stewardship schemes.

Discussion Questions

Summarise the advantages and disadvantages of New Zealand's population distribution from (i) an economic perspective and (ii) an environmental perspective.

How can spatial planning help to improve the quality of the environment?

How might the environmental impact of raising urban density in Auckland differ from the impact of increasing urban density in one of New Zealand's smaller cities?

Explain how the environmental advantages of a certified green building might vary according to the location of the building?

Why do some environmentalists raise objections to a focus on waste minimisation?

Explain what information is needed to provide an evaluation of New Zealand's record for recycling household waste?

Describe the extent of the solid waste problem in New Zealand.

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Chapter 10
Reflections and Prospects

Key Questions

- What views exist about the state of New Zealand's environment?
- What has this book identified as the key environmental challenges?
- What are the prospects for green growth?
- What are the prospects of business prioritising green growth?
- How is and can local action contribute to environmental management?
- How can you keep in touch the management and state of the environment in New Zealand?

Abstract Views about the state of New Zealand's environment vary from those seeing it as pristine to those who believe the environment has been largely destroyed. Our own assessment identifies a number of weaknesses particularly with respect to environmental data, the protection of lowland, coastal and ocean ecosystems, pest control techniques, urban air quality and carbon emissions. An aspect of new environmentalism is that ideas and judgements about the nature of environmental problems and the required responses can gain momentum quickly and fuel environmental activism that is poorly informed. The campaign for local food is one illustration of this which has been of particular significance for New Zealand. The dangers of new environmentalism are shown by the way some of the claims about the benefits of local food are misleading, capable of being captured by big business rather encouraging local entrepreneurialism and are partly elitist in the interests served. Belief in the possibility of green growth is another aspect of the new environmentalism where prospects are mixed. Confidence in the ability of market-based instruments to resolve environmental problems is not supported by their use and the business community as a whole is not increasing its support for green business strategy. Public support may be greater for environmental protection when economic development is seen to threaten conservation. Some of the gaps in environmental management are addressed through large numbers of community-based environmental projects.

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The final part of the chapter provides guidance on how to keep in touch with developments affecting the state of the environment in New Zealand.

Key Concepts and Terms Community Environment Fund • Environmental perceptions • Environmental values • Foodmiles • Green growth prospects • Local food • New environmentalism • OECD and green growth • Politics of conversion • Politics of respect • State of the environment • Sustainable Farming Fund

10.1 What Others Think

At the start of the new century the government's environmental commissioner regretted that New Zealand had failed to establish itself as a leading light on sustainable development (Parliamentary Commissioner for the Environment 2002: 122). In the Commissioner's view, relatively low population density and predominantly land-based economy ought to have made stringent environmental management a natural choice to underpin the country's development. In contrast, the link between economic growth and increased environmental impacts has yet to be broken which some see as a sign that the economy remains on an unsustainable path. The lack of a strong sustainability commitment is something that others have also criticised New Zealand for. One perspective is that many New Zealanders have been deluded by the 'clean green' mantra promoted by superficial evaluations which encourages them to overlook the deep seated and complex environment problems actually faced (Wallace 1997). Some go further, as with a 'green' tourism web site which while not always being factually accurate voices concerns that have the potential to be held widely.

> People came to New Zealand to build a new life in a green land and visitors today arrive with many romantic images in mind. With a population of only 3.6 million, you would expect human interference to be limited but the country is in fact one of the most bizarre ecological disasters in the history of man. Forest cover has been reduced from about 85% since human colonisation, while nearly three-quarters of the land area is given over to the production of food and commercial forestry, the latter essential to the national economy. Most of the trees are quick-growing radiata pine, an American species introduced because it is more profitable than any native variety; these days just ten percent of native forest remains.
>
> The increase in demand for forestry- and wet-land goes unabated, even though commercial timber milling turns areas into virtual lunar deserts dotted with tree stumps. A by-product is added air pollution from fume-spitting, 18-wheeler logging trucks. And despite a sustained programme to eradicate them, pests like possums wild deer, goats and rabbits pose a serious threat to the country's economic welfare. (http://www.newzealandtraveldiscount.info/green_issues.htm. Accessed October 18, 2011)

In stark contrast, a former chief executive of the Ministry for the Environment released a parting commentary that spoke of New Zealand as both beautiful in nature and management, populated by "people treading gently and leaving soft footprints on this paradise" (Ministry for the Environment 2006: 5). He refers to New Zealand as one of the gems of the natural environment. He identified many areas where it could be claimed that environmental conditions were significantly improving and noted that remaining problem areas were being addressed. At around the same time, another contrasting viewpoint came from the head of New Zealand's main farmer group Federated Farmers. In an address to its 2006 national conference, the President of the farmers group argued that environmental management had gone too far and had become a 'handbrake on economic prosperity' (Pedersen 2006). This criticism linked to a campaign being run by Federated Farmers against parts of the Resource Management Act that they see as too restrictive of farming activity.

These differing viewpoints illustrate the contentious nature of environmental management and the great variety of opinions on the condition of New Zealand's environment. A judgment on the current state of the environment is informed by perceived responsibilities to future generations and to other species as well as by objective environmental data. In New Zealand's case, gaps in the environmental monitoring database and lack of state of the environment reporting accentuate the possibility for individual assessments to deviate from reality. The extent to which economic activity generates resources that can be applied to environmental management as compared with economic activity inevitably being at the expense of the environment is an additional source of disagreement. For example, Federated Farmers campaign against the Resource Management Act partly because they believe resource managers are too focused on controlling activities rather than managing the actual effects of activities.

Many if not most people take pride in their efforts to care for the world around them without spoiling it for others. In this sense most people can claim to be an 'environmentalist'. There are others who believe that the level of environmental destruction occurring is on a scale that something more than an expression of concern is required. At the extreme some green activists even see justification for a suspension of democracy to ensure that action is taken with respect to the perceived seriousness of the global environmental crises. Others refer to this activism as the 'politics of conversion' (Childs 2003; DuPuis and Goodman 2005: 361). A small, unrepresentative group assert preferences as to what is in everyone's best interest and then seeks to change the world by converting others to their point of view. This contrasts with the 'politics of respect' which avoids the presentation of idealised futures as attainable entities and instead supports debate between persons representative of different sections of society on the directions of change that might be pursued. The difficulty of course is that the unequal distribution of power and resources in society makes it hard for dialogue to occur between representatives of different social groups.

10.2 New Environmentalism and the Competition for Ideas

'New environmentalism' exposes New Zealand to the politics of conversion, not just from green activists but as well from other lobby groups who are inclined to view their own self interest as environmentally responsible. Motivated campaigners are able to gain a profile for their ideas much more quickly than in the past with modern means of communication. This is seen with the campaign for ‘local food’ and the claim of securing a ‘double dividend’ from encouraging increased local production of food for local consumption. In many respects this campaign shows the potential and the pitfalls of the new environmentalism.

Advocacy of local food for local consumption has various motivations. The motivation may sometimes be driven by concerns about the rise of capitalist agriculture, the ethics associated with globalised food production and the loss of local distinctiveness (Friedmann 1994; Hendrickson and Heffernan 2002; Murdoch and Miele 1999, 2002; Murdoch et al. 2000). An economic motivation arises where the emphasis shifts to the concern to reduce ‘food miles’ (Paxton 1994), the value of short food supply chains (Marsden et al. 1999; Renting et al. 2003) and the opportunities for promoting ecological entrepreneurship (Adams 2002; Marsden and Smith 2005). Advocates of locally based food production see opportunities for ‘recovering a sense of community’ (Esteva 1994), basing food production on an ‘ethic of care’ (Holloway and Kneafsey 2004) and aligning food production with local ecologies (Murdoch et al. 2000). Others see it as part of a larger social movement in which conscious consumption should displace conspicuous consumption and ‘slow food’ should take the place of ‘fast food’ (Honore 2004; Hamilton 2005). While the agendas are mixed the profile of local food is enhanced through the rapid spread of ideas and ability to use modern technology to build connections between producers and consumers. Three facets of the local food campaign are also important to note.

First, some parts of the campaign are manifestly misleading. The environmental benefits of local provisioning do not escape serious questioning particularly when linked to the claimed benefits of reduced ‘foodmiles’ (DEFRA 2005; Wyen and Vanzetti 2008). This phrase originated in the early 1990s to refer to the distance that food products travel between their place of production and final sale to end consumers (Paxton 1994). The inference was that the further the distance travelled the greater was the environmental impact, a message that was taken up by environmental campaign groups and academic proponents of eco-localism (Curtis 2003). In the context of public concern over global warming, the association between distance and environmental impact attracted wide attention partly as it offered concerned households an intuitively appealing way to combat human-caused climate change that was easy to comply with. The concept has since been discredited as a meaningful measure of environmental impact for three main reasons.

- The environmental impacts of transporting food products capture only part of the food production lifecycle. The impact of long distance freight can be offset by comparatively low environmental impacts during the production and harvesting phases. It has been shown, for example, that the energy consumed in the production, distribution and sale of dairy products, lamb, apples and onions from New Zealand in the UK is less than that associated with more locally sourced alternatives even after taking into account the difference in freighting distance (Saunders et al. 2006). Similar calculations have been made when comparing the energy used in the production of lambs in New Zealand and Germany (Schlich and Fleissner 2003) and when comparing roses grown in Kenya versus those grown in the Netherlands (Williams 2006).

- Distance travelled does not take into account the relative impacts of different travel modes. Carbon emissions from long haul air freight are over 100 times larger than those from sea freight (DEFRA 2005). Excluding localised pollution impacts around major sea ports, there can be environmental gains when relatively short distance air freight is replaced by long distance sea freight.
- The focus on food miles overlooks how distribution in the end market can account for a large share of the environmental costs. A standard British shopping trip by car of 6.4 km to collect a weekly purchase of groceries (20 km) can use the same energy required to transport the same weight over 8,500 km by sea (Heyes and Smith 2008). Consequently, up to two thirds of the total environmental impacts can be accounted for when environmental assessments focus on final distribution to the point of sale, shopping trips and on-farm production externalities.

Bearing in mind the extent to which a focus on foodmiles alone is misleading, any shift in consumer purchases responding to this issue has the potential to cause a net increase in environmental externalities and a loss of income in food producing nations that are distant from their markets (Ballingall and Winchester 2009). These losses might have some justification if environmentally sensitive local production grows to replace more conventional methods of production. In practice, much of the popular concern with foodmiles is driven by market protectionism, opportunity for conventional enterprise to obtain commercial advantages and food security concerns.

Second, while many who join the campaign target the growth of an alternative economy based on locally-owned, small scale businesses, it is evident that one reason for the success of the campaign is its compatibility with big business. In open economies, it can be assumed that opportunities for increased income will attract the attention of competing producers. This means that to sustain the initial income advantage there must be something about the product and its production that maintains barriers to market entry. In contrast, elements of an apparently alternative food production model are comparatively easy to replicate in terms of qualities such as ‘traditional’, ‘fresh’, ‘local’ and ‘organic’. Indeed, supermarket chains have frequently acted quickly to source ‘local’ foods and in some respects are strongly positioned to take advantage of any growth in demand for non-conventional food products (Banks and Bristow 1999). For example, the UK supermarket chain Waitrose has classified 500 of its suppliers as ‘local’ and includes dedicated display areas for some of their produce (John Lewis Partnership 2009: 8). Similarly, the international supermarket chain Tesco reports substantial growth in the sale of local produce (Hawkes 2008). In the minds of many consumers, conventionally produced foods are as likely to be considered local products as are organically produced foods (Winter 2003). Particularly where consumer interest is motivated by food quality concerns, corporate food retailers have modified their supply chain management to incorporate heightened product traceability which includes more recognition of the source locality and methods of production. Similarly, locality branding schemes may put the emphasis on locality characteristics rather than specific methods of production with a consequence that conventional enterprise can benefit as well as enterprises adhering to strong sustainability practices. Traditional centres of artisan food production may gain but as discussed in the case of the Parmesan cheese cluster, artisan producers exist under a constant cost-price squeeze that originates in the plentiful availability of close industrial substitutes (de Roest and Menghi 2000).

Third, the campaign for local food is most strongly supported by a narrow range of consumers who might broadly be characterised as elitist and that may give more priority to ecological sustainability over social justice (Allen et al. 2003). A study in New Zealand of the affinity between Māori and the country's largest discount retailer has suggested similar evidence of elitism in the claimed damage to community well-being from externally owned enterprise.

The Warehouse Group owns New Zealand's largest chain of discount general merchandize stores. The group's 'red sheds' have spread from cities to smaller towns frequently in the face of opposition from local retailers. Sayers et al. (2008) assess what Māori organisations and individuals in three small towns felt about the red sheds. While represented in all socio economic categories, a disproportionate share of Māori have low incomes, experience of unemployment and poor health. In the small towns studied, Māori make more frequent trips to a red shed than do other ethnic groups, are more positive about the service provided, more responsive to special promotions and more inclined to include a visit to the store as part of a 'day out'. From these and related observations, the investigators suggest that Māori have 'appropriated' the store as a social and cultural addition to their life rather than being passive victims of the consumerism that the store encourages. One reason for this is that the Warehouse stores employ Māori and are regarded by them as a good place to work compared with other retail chains. Some Māori informants also comment on their comfort when shopping in a warehouse store layout compared with a traditional store where there can be a feeling that 'someone is watching you'. These endorsements lead to the suggestion that critiques of 'big box retailers' such as Wal-Mart are affected by romantic and nostalgic ideas about what constitutes a community that overlook how not everyone was happy with the Main Street of old.

The approach in this book has been to encourage careful analysis and reflection on issues before offering a prescription. One generalisation is that environmental problems are complex and best addressed with a flexible, results-oriented approach. People and their values matter and as a consequence environmental problems must be analysed and solved with reference to individuals and circumstances. In some circumstances, recognising that there can be a need to create incentives for people to act as responsible environmental custodians, market forces can be important instruments for problem solving. Equally, recent experience points to the dangers of unleashing market forces to address environmental issues. The explosion of trading in carbon credits derived from various forms of offsetting demonstrates how incentives need careful management. The growth of offsetting can be credited with increasing business interest in climate change and social responsibility but this has been partly on the basis that buying offsets requires no great change in business behaviour.

As explained by the New Zealand infrastructure company Infratil, one reason for it addressing human-caused climate change by reducing its net carbon emissions is that it need not cost much to do so. As it says 'rather than the prospect of giving up the trappings of western society in favour of home-spun clothing and a diet of lentils, the cost is likely to be about 1% of the world's GDP' (Infratil 2007: 22). This costing is based on the use of offsetting as one of the tools for managing carbon credits, but it is increasingly evident that most offsetting fails any rigorous additionality test. The uncertainty is whether climate change would continue to attract the attention it currently has should a more rigorous policy regime be put in place.

10.3 New Zealand Environment Strengths and Weaknesses

An element of judgement and preference will continue to allow different verdicts to emerge on the state of New Zealand's environment. Using ecological footprint analysis, it can be shown that New Zealand lives within its ecological resources when assessed in isolation. When used for ecological comparison, adjusting for differences in land productivity, New Zealand appears to be overshooting its ecological capacity with a performance similar to many other high income countries. Assessing environmental performance using a range of environmental indicators is equally capable of producing contradictory assessments of New Zealand's environmental performance according to the mix and definition of individual indicators. Nonetheless it is possible to conclude that in many respects New Zealand is distinguished by the abundance and quality of its natural environment, although loss of biodiversity, certain indicators of air quality and risks to water pollution are areas of weakness. Less positively, it is evident that there are many areas where the real state of the New Zealand environment remains unclear because of a lack of data.

An upgrading of the database for monitoring the quality of the environment could help promote more agreement or at least challenge opposing views to substantiate their claims. A common theme across our inventory of New Zealand's environmental challenges is the lack of environmental information. Pockets of good quality data do exist, but in many areas monitoring data tend to be limited spatially, temporally and by topic. Indicators of waste were developed in 2000 and the marine environment in 2005 with indicators on air, freshwater, biodiversity and land pending and work going on related to energy, toxins, animal pests, weeds and Māori and amenity values. Even so, the OECD in 2007 (OECD 2007: 172) was critical of the slow progress in developing indicators especially ones dealing with environmental pressures capable of informing a 'pressure-state-response' evaluation framework. This constrains the ability to report authoritatively on national trends. The situation has improved since the release of a government State of the Environment report in 1997 (Ministry for the Environment 1997), although the report itself has not been kept up to date despite a commitment in the Environment 2010 Strategy to produce such reports every 4 years. A second state of the environment report was not published until 2007 although the Ministry for the Environment has released environment report cards on a range of topics since the second report was published.

For the present, it is frequently necessary to report on the changing condition of particular environments without the ability to know whether individual experiences are reflective of national trends. With that limitation, the following are our verdicts on the state of the environment.

10.3.1 The Land

In regard to the land and biodiversity, the main pressures are the insufficient extent of indigenous lowland ecosystems, the declining quality of those that do exist and the impacts of pests and weeds. The need for partial restoration of representative lowland and freshwater ecosystems has been recognised but insufficiently acted upon. At the same time there is evidence that several strains and varieties of beneficial exotic species may be disappearing and that this may have significant long term economic impacts on New Zealand's agriculture, horticulture and forestry. Pest control affecting these and native species needs to be made safer, more humane and cost effective to remain economically and socially sustainable. Freshwater quality and flows are under four main pressures: drainage and channelisation that reduces wetlands and alters the former state of the aquatic environment; deforestation (frequently now of exotic species) that intensifies flooding and sedimentation in steep catchments; increasing demand for urban water supplies and for livestock and irrigation; non-point sources of pollution mainly from animal waste runoff from pastures, fertiliser, sediments and paved surfaces in urban areas. There has been much improvement in the control of point source discharges such as sewage, factory and dairy shed outfalls but local problems remain.

10.3.2 Oceans and Coasts

Turning to the oceans and coastal environment, both remain under-represented in the protected areas of New Zealand. The number of marine reserves has increased in recent years, but these are restricted to the 12 nautical mile limit and leave aside deepwater ecosystems and special environments such as seamounts. Since 1996, fisheries legislation has required that measures be taken to reduce the catch of marine mammals, birds and marine invertebrates such as corals, but serious problems from bottom trawling and incidental capture remain. Over 100 fish species are commercially exploited, but the pressure is intense on a few species that make up most of the value of the catch. These species are controlled by a quota management system that seeks to restrict catches to within the maximum sustainable yield. The management system has been judged advanced by comparison with management elsewhere in the Pacific, but imprecise estimates of fish stocks, limited understanding of population dynamics and political pressure to maintain fishing levels remain a challenge to achieving a truly sustainable fishery.

The coastal environment has been recognised as an environment under particular development pressure and away from urban areas coastal waters are generally of high quality. Until comparatively recently, disposal of untreated sewerage in coastal waters was a frequent occurrence, but systems are being upgraded with beneficial outcomes. Problems remain with ageing and inadequate sewerage systems in some coastal areas, including those adjacent to marine environments prized for their recreational, cultural and ecosystem resources, such as the Bay of Islands. Generally, only the quality of individual estuarine environments can be commented upon and controversy exists about the pressures they are experiencing.

10.3.3 The Air

With respect to air emissions and air quality, several influences have assisted performance. Location, an exceptionally well ventilated airshed, climate, physical geography, economy and a relatively small population mean that New Zealand has good air quality. Exceptions exist for some of the larger urban areas, notably Auckland because of air pollution from transport and Christchurch because of emissions from road vehicles and household heating fires in winter (although the latter are now restricted). The otherwise good overall quality can explain the relative absence of emission controls, including the lack of minimum standards for motor vehicles. This has allowed the import of used vehicles from countries that have tightened their emission standards and results in a car fleet that is comparatively poor in air pollution and fuel efficiency performance. In other areas, regulation has been tightened with 14 standards for air quality introduced in 2004 for implementation of various time periods. As well, New Zealand is a signatory to the Kyoto Protocol that seeks to reduce emissions of carbon dioxide from road and air transport, industries and power plants. The pact requires that New Zealand reduce such emissions by 2012 to what they were in 1990, but it is now clear the goal will not be met. One report shows that New Zealand had the second highest percentage increase of carbon dioxide emissions among OECD countries from 1990 to 2000. One reason for this is poor energy efficiency and a tendency to offset improvements in efficiency where they occur by increased consumption. Another challenge is that the ability to offset carbon emissions by carbon sinks has not eventuated as the government had originally intended. During the early 1990s, the area of forest planting was growing at up to 100,000 ha a year because of a boom in forest plantation investment. Subsequently, new forestry investment has declined partly because of a revival of alternative land uses that are net carbon emitters (sheep and beef farming). Similarly, New Zealand was an early leader in implementing the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, but in 2004, along with ten other developed countries, sought exemption from full implementation.

10.4 Prospects for Green Growth

The OECD has championed the possibility of green growth spurring a new wave of economic growth while containing environmental impacts (see Chap. 1). In its 2011 review of the New Zealand economy, three main constraints on the prospects for green growth were identified: (i) inadequate governance for sustainable development policy; (ii) too little use of market-based instruments; (iii) insufficient pricing of carbon to address climate change (OECD 2011: 163–164). With respect to governance, the OECD like the Parliamentary Commissioner for the Environment believes that the new Environmental Protection Authority has potential to strengthen environmental management providing that it is sufficiently well-resourced and is able to exercise policy leadership. The OECD also identified a need for greater integration of the environmental management system including some strengthening of the mechanisms associated with the Resource Management Act in the form of national policy statements and standards and investment to enhance the regulatory capacity of local authorities. As noted in Chap. 3, this direction of change was part of the reform envisaged more in the 2005 agenda than the 2009 round of change.

The OECD recommends greater integration of land use and water use planning from the perspective that more incentives need to be provided to ensure that scarce water resources are directed to the highest value users. The OECD particularly dislikes a system where resource consents ration water on a 'first-come, first served basis' (OECD 2011: 140). This it sees happening when access to water is controlled by a consent that may last for several decades with a tendency for existing consent holders to have priority over new users when renewal is needed. A response to this is already available in that the Resource Management Act was modified to allow trading in water rights, but little use has been made of this flexibility (Box 10.1). Given the increasing pressure on water resources through agricultural intensification and urban growth there is a need for further policy innovation. This is already evident in the setting up of the Land and Water Forum to engage with interested parties in the design of new policy under the Fresh Start for Freshwater Programme. As in other areas where environmental management has been weak a first priority is to strengthen the information base with greater understanding of the nature and extent of the competition for water being a first step in developing a way forward.

Box 10.1 Discussion Point: What Financial Incentive with Transferable Water Permits? (Source: Fenemor and Sinner 2005)

The Resource Management Act enables water permits giving rights to draw on groundwater to be transferred from site to site within the same water resource if the transfer is either approved by individual resource consents or allowed in a regional plan that sets out a scheme for managing permit transfers. In theory, transfers of permits would encourage water allocations to the highest value land uses and promote efficient water use. In practice, regional councils have shown little interest in establishing permit transfer schemes.

Box 10.1 (continued)

An exception is Tasman District Council's adoption of a permit transfer scheme for part of the Waimea Basin in place of the existing 'use it or lose it' approach. Investigation of such a scheme started in 1993, focused on the Waimea Basin because its water resources were fully allocated in 1996. A transfer scheme was finally introduced in 2006 but only for the small Wai-iti catchment excluding the Waimea Plains. The larger scheme was opposed by water users. Ownership of a water permit was akin to joining a 'closed club' and facilitating transfers was seen as upsetting existing social relations. It might lead to the formation of an exclusive club of permit holders that had the money to buy out other permit holders. There was also opposition on the grounds that trading would result in water take being more frequently pushed to the limits.

The Wai-iti catchment was open to a transfer scheme because water here was over committed and likely to lead to a reduction in existing allocation. At the same time an augmentation scheme was being designed that would give a larger, more secure water supply. It lessened the perception of transferability being a threat to existing entitlements. Existing users were funding the enhancement and this gave insight into the potential financial value of permits, encouraging transferable permits to be seen as a valuable property right. In the past, permit reviews had sometimes led to water allocations being lost, so there was some perception that the present system gave uncertain entitlements. The possibility of relocating water extraction closer to the river also added to the acceptance among some existing permit holders. Added to this, the 'use it or lose it' regime disadvantaged land owners with an existing unused permit (some land was being held as retirement blocks). The transfer scheme protected their water rights and associated property value.

The scheme gained acceptance of Māori whose interests as owners of land leased to permit holders potentially differed from owner occupiers. To avoid the risk of Māori land becoming dry, special rules ensured that water allocations would be reserved for land in two management areas.

Critical thinking question: How does the Tasman experience help explain why transferable water permits are less frequently used to allocate water than 'use it or lose it' permits?

The second area of OECD concern is New Zealand's limited use of market-based instruments. As discussed in Chaps. 2 and 3, this has been a long standing position which has had little response in the reform of environmental policy, although the introduction of waste levies and the emissions trading scheme are exceptions. The experience of the Lake Taupo Trust is seen to illustrate the benefits that can be obtained by facilitating the trading of pollution rights. Based on information in the OECD's summary of the Trust's operation there are reasons to believe that further time is needed to judge its effectiveness (OECD 2011: 143–144). As the OECD notes, the original trading scheme was forced to allocate too high a volume of nitrogen pollution rights, the same issue as the Parliamentary Commissioner for the Environment (2011) sees as weakening the emissions trading scheme. The continued operation of a form of pollution rights trading has depended on the financial injection made by the Trust and the linkage with the emissions trading scheme. Rather than trading in the rights to use nitrogen, and subjecting the use of nitrogen around Lake Taupo to a cap set according to the volume compatible with maintaining lake water quality, farmers are converting some of their land to forest. The outstanding questions relate to the enduring acceptance of tree planting as an offset for carbon emissions and the extent to which conversion of farmland to forest achieves the reduction in nitrogen use. It should also be noted that while the OECD opposes 'command and control' as the policy default position, a requirement for farmers to obtain a resource consent to continue farming set the context in which nitrogen trading was introduced.

Climate change policy is the third area in which the OECD saw opportunity to strengthen green growth prospects. Uncertainty as to what policy agreement if any may emerge when the Kyoto Protocol ends in 2012 and the political differences within New Zealand over the long term future of the emissions trading scheme bedevils progress in this area. One response is to give priority to initiatives that offer multiple environmental benefits so that action is not dependent on the existence of climate change policy alone. In this regard there is value in recommendations to maintain afforestation grant schemes that help to control soil erosion, encourage indigenous forest planting (as compared with exotic tree planting) and investment in research and development in areas such as smart metering, pastoral emissions mitigation and biodiesel.

The nature of the OECD is that its concern is mainly with the management of the economy and the public policy environment. The prospects for green growth are also shaped by the attitudes of people and business.

10.4.1 Public Support for Green Growth

When values in general are explored, it can appear that people in New Zealand are motivated to protect the environment. An international survey of public opinion undertaken in 1997 found that New Zealand was among the populations that most strongly favoured environmental protection over economic growth (Environics International 1997). (The survey continues, now administered by GlobeScan Inc, but New Zealand is no longer among the participants.) This priority is confirmed in the 2005 New Zealand Values Survey (Rose et al. 2005). This survey suggests New Zealand's population is predisposed to support of environmental protection.

- Two thirds of respondents agree that 'protecting the environment should be given priority, even if it causes slower economic growth and some loss of jobs'. The support is highest among those aged 25–44, but at least 60% of all age groups give this response.

- A larger majority (90%) agree that 'economic growth should only occur if it does not cause lasting damage to the environment'. Age does not influence support for this proposition, but it is most likely to be supported by those with tertiary education.
- A majority of the population appear willing to make further financial contributions to protect the environment: 60% of respondents agree with the statement 'I would give part of my income if I were certain that the money would be used to prevent environmental pollution' and 52% indicate 'I would agree to an increase in taxes if the extra money were used to prevent environmental pollution'. On these issues, there is significant variation in the level of agreement by age in the case of the first statement and education level in the second statement.
- A high quality natural environment received the second highest overall rating (after a good public health system) in terms of its importance in influencing respondents' preferences to spend most of the rest of their lives in New Zealand.

A tendency for respondents to provide 'socially desirable' responses is a well known limitation on using interview surveys to reveal personal values (Saunders et al. 2003). Consequently, while the environment gets a high ranking, so do other public issues. For this reason, comparing changes between surveys can be more insightful than examining responses at one point in time. The 1989 New Zealand Study of Values also reported that environment protection was a greater priority for most respondents than 'living standards' (Gold and Webster 1990). Whereas the proportion might have been expected to increase over a decade where environmental issues such as ozone depletion and climate change came to the fore the share was again slightly below two thirds of respondents.

Whatever the data uncertainty, the extent to which people in New Zealand apparently favour lifestyle over maximising economic growth was a concern to a government advisory board on 'growth and innovation' (GIAB). In 2004, GIAB commissioned a national survey of 750 people to identify public attitudes to economic growth partly to determine whether more effort was justified to raise the social status of entrepreneurs (GIAB and UMR Ltd 2004). The survey respondents ranked economic growth tenth out of twelve aspects of New Zealand that were personally important to them. Quality of life, education and the environment were the most frequently identified priorities. The GIAB interpreted the findings as indicative of how people in New Zealand support economic growth only to the extent that this does not conflict with their quality of life and environmental values. Somewhat in contradiction with this, current wage levels and rates of economic growth were sources of dissatisfaction with most respondents wanting more of both. In contrast, most people were satisfied with the quality of the natural environment as it existed.

The proposals to open up more publicly-owned land for mining can partly be viewed as a test of this past research into New Zealanders' environmental values. New Zealand has large untapped mineral wealth including coal reserves that in terms of energy content per capita are large than Saudi Arabia's oil reserves (OECD 2011: 148). To date there has been widespread unease about the possibility of exploiting more of the country's mineral wealth which exists both under the land and under the sea. The representativeness of the opposition is not clear but the government step down from its original intentions of opening more of the conservation estate to mining may confirm that New Zealanders value at least maintaining the current state of the environment.

10.4.2 Business Support for Green Growth

The prospects for green growth will be enhanced by positive business commitment to improving New Zealand's environmental performance. An Advisory Group on Green Growth appointed by the government in 2011 was directed to examine how the export industry could make greater use of clean technology and how small and medium-sized enterprises (SMEs) could be assisted to become more energy efficient. As expressed by the government ministers supporting the taskforce, it is about enabling New Zealand to grow the economy while enhancing its clean, green brand. The context for this taskforce is that business commitment to environmental and social responsibility has been lukewarm.

A representative survey of businesses (excluding those with less than five employees) found that most had not addressed the environmental impacts of their business (Knuckey and Johnston 2002: 53). Inactivity was rationalised by the perception of being free of environmental impacts, but government analysts judged that three quarters of the businesses that had not introduced environmental measures should have done so. Within the context of the same study, a group of 'leading' firms was identified that had invested in many of the business practices thought to distinguish progressive and successful enterprises but even these were judged to have invested less in environmental measures than they should have. For example, a quarter of the leading firms had obtained or were planning to obtain some form of environmental certification, such as ISO 14000, but this rate of receipt was considered much less than it needed to be (Knuckey and Johnston 2002: 53). A survey in 2006 of New Zealand's top companies concluded that they lagged behind their international counterparts in reporting their sustainability performance (Collins et al. 2010a: 480). A Landcare Research survey of the food and beverage sector in New Zealand (Stancu and Smith 2007) found that sustainability was not gaining much attention with respect to long term strategy. Similarly, a survey of businesses in Germany and New Zealand found that in both countries there was a general lack of interest in sustainability as part of the formal business planning process (Mueller et al. 2007). A later study of 15 large organisations found that less than half report on their environmental performance (Eweje 2011).

Researchers at Waikato University have tracked business participation in environmental and social initiatives over three surveys in 2003, 2006 and 2009 and find no clear sign that green growth is gathering momentum (Collins et al. 2010b). Between the first surveys there was an increase in the number of companies adopting environmental practices, but much of the activity was rudimentary such as separating waste for recycling and participation has not shown a continued upward trend. The conclusion of the 2010 survey is that while there is steady growth in the number of companies marketing their products or services on a basis of environmental claims such as 'clean, green New Zealand' the majority of New Zealand companies are reducing their uptake of sustainability practices (Collins et al. 2010b: 25). This leads the researchers to suggest that unless there is more real commitment to environmental responsibility New Zealand's branding around the quality of the environment could be damaged.

As noted in Chap. 1, the message that business in New Zealand is not investing enough in environmentally-based strategies has motivated the formation of a new lobby group known as Pure Advantage. It is certainly the case that there are only a few companies in New Zealand that are in a position to claim that their environmental performance is a core part of their competitive strategy. The formation of the new lobby group has also to be seen in the context that the longer established New Zealand Business Council for Sustainable Development (NZBCSD) has lost members. A difference between NZBCSD and Pure Advantage is that the former addresses sustainability from a society perspective recognising the role of public policy as well as individual business strategies, Pure Advantage limits itself to persuading companies of the virtues of green business strategies. The success of this group will, therefore, depend on how widespread are the opportunities for individual companies to simultaneously enhance their environmental and business performance.

10.5 Community and Individual Action

As well as central government commitment to the environment and the range of tools at its disposal, local action and community initiatives are another source of change. Indeed large amounts of community-based activity are being supported through small scale grants to land owners, community organisations and iwi. This activity can be important in helping to protect pockets of biodiversity that are not well represented in the national conservation estate, such as lowland forests, dune systems and freshwater wetlands (Davis and Cocklin 2001). Equally it can help to give an outlet for the environmental concerns of individuals and groups. For students interested in the environment because they wish to see change, as well as from an academic interest in New Zealand's environmental challenges and responses, some of the groups and projects being funded may provide a tangible way of contributing to a solution to some of New Zealand's environmental challenges. Evaluating the contribution of local action is as well an interesting topic for research reports and theses.

In 2000, a Biodiversity on Private Lands package gave funding for the Biodiversity Advice Fund and the Biodiversity Condition Fund and expended the investment in related existing funds and trusts including the Nature Heritage Fund, Nga Whenua Rahui and Queen Elizabeth II Trust. In the same year, the Ministry of Agriculture and Forestry (MAF) established the Sustainable Farming Fund to support projects that could help agricultural producers reconcile economic, social and environmental objectives. This fund followed the setting up of the New Zealand Landcare Trust in 1996 as a contribution to the Sustainable Land Management Strategy. Up to 2000, Landcare Trust was funded from the Ministry for the Environment, but since then has operated with support of Transpower to provide not-for-profit community groups with project grants of up $5,000 a year. By contrast, after 10 years of operation, the Sustainable Farming Fund administered by MAF had invested around $200 million in over 700 projects with individual grants ranging from a few thousand dollars to several hundred thousand. In 2005, a Significant Community Based Projects Fund added a further funding source for local action with a commitment of $32 million over 4 years to be concentrated on a few major projects. The Maungatautari Ecological Trust was a successful applicant in the initial application round, receiving $5.5 million toward the cost of establishing an ecological island reserve. The Karori Wildlife Sanctuary, another similar project but located in an urban (Wellington) context has received funding.

The Biodiversity Advice and Condition Funds provide money for pest management on privately owned land while the Natural Heritage Fund supports the legal protection of biodiversity values. That protection may be realised through public acquisition and transfer to the national conservation estate or through the setting of covenants on privately owned land that register specific management obligations on the ownership title. Nga Whenua Rahui, a fund established in 1991 by the Department of Conservation, can have a similar outcome, but is targeted specifically to the protection of indigenous flora and fauna on Māori-owned land. It is geared toward dealing with the dispersed ownership of Māori land. Māori own about 6% of New Zealand's total land area divided among 2.3 million titles which is a similar number to the ownership interests linked to the remaining 94% of the country. On average, there are 62 owners per Māori land title: at one extreme, 10% of Māori land titles have a single owner, at the other extreme 10% have an average 425 owners (New Zealand Controller and Auditor General 2004). Nga Whenua Rahui funding is mainly to iwi to assist the placing of kawenata (covenant) over land or formal protection through designation as a reserve. Funding supports the legal registration of the designation, physical protection and sometimes payment in lieu of forgone income opportunities.

A forest protection project in the Mangaroa/Ohotu kawenta area of the Bay of Plenty east of Opotiki is one of the projects supported by Nga Whenua Rahui. The Mangaroa/Ohotu Trust established by Te Whanau A Apanui received funding to help restore an area of bush that was rapidly deteriorating because of pests. The Mangaroa/Ohotu Trust wished to restore both the physical and spiritual balance of their forest and reintroduce the kokako, a bird iconic to their iwi. The principal pests in the Mangaroa/Ohotu were ones common to many areas: goats, possums, rats, stoats and deer. Through an intensively applied combination of methods the Department of Conservation report that they are now under control and that the forest is regenerating and bird numbers increasing. This includes the successful translocation of kokako back to the home where it was once common. The pest control programme that made the reintroduction possible is seen to offer a procedure that can be applied to other species transfers in other areas. In total, by 2006 Nga Whenua

Rahui had supported the management of pest related issues on over 250,000 ha of covenanted land. Nga Whenua Rahui has existed since 1991 and in 2000 was expanded with the addition of the Matauranga Kura Taiao Fund for initiatives to retain and promote traditional Māori knowledge and its use in biodiversity management. The Fund is part of the New Zealand Biodiversity Strategy, which gives recognition to tangata whenua and matauranga Māori in biodiversity management.

The Queen Elizabeth II Trust is independent of government being established in 1977 to promote the protection and enhancement of natural areas on privately owned land. It encourages the signing of open space covenants that control the future use of the land and are registered with the Trust (Bayfield 2004). The area of land covered under this arrangement almost doubled over the decade to 2006 indicating the extent to which private landowners have been motivated to ensure continuing protection of indigenous habitats. With almost 100,000 ha now protected by the Trust's covenants the land area is equivalent to over a fifth of the area protected as national parks.

The Ministry for the Environment administers a Community Environment Fund (CEF) to support community-based environmental action. A limitation of this initiative is that projects are expected to be for a limited time period of up to 3 years. The fund replaced an earlier scheme that had helped establish 26 community environment centres. The Centres had promoted public awareness of environmental issues and provide sustainable development information, especially to students. The annual green ribbon awards distributed by the Ministry for the Environment are also designed partly to promote awareness of community environmental initiatives.

10.6 Keeping in Touch with the State of the Environment

Policy changes are an ongoing aspect of environmental management. Understanding of environmental conditions and changes in scientific and public concerns add to the dynamic nature of the debates around the state of the environment. As noted at several points during this book, many gaps exist in the data ideally required to monitor changes in environmental conditions and in the extent of reporting provided by public agencies. Nonetheless it is important to keep track with the information that is available and to be aware of new areas of policy development. The Ministry for the Environment and Parliamentary Commissioner for the Environment are two key official sources of information to stay in touch with. It can be particularly helpful to look at the post-election briefings they prepare to inform incoming ministers of the policy priorities they identify. The OECD is another important source of official information. It undertakes a comprehensive review of environmental policy in New Zealand every 10 years but may also comment on environmental matters in its annual economic survey of New Zealand. It also produces reports on the policy developments it seeks to advocate with the area of 'green growth' being a topic that is currently being given a lot of attention. The OECD policy perspective should be checked against that of other agencies but their outlook is important because public policy makers tend to be influenced by their commentaries.

Local government agencies such as district and regional councils are often a good source of information as they periodically file state of the environment reports for their regions. Most of these reports are put on the local authorities' websites. Most regional a district councils regularly post material on their websites relating to those aspects of the environment for which they are responsible.

For keeping in touch with of the state of the terrestrial environment, including freshwater, government land agencies are a useful source of information. The main ones are MfE, Ministry of Agriculture and Forestry (MAF), Department of Conservation (DoC) and the Parliamentary Commissioner for the Environment (PCE), NIWA and Landcare. There is a New Zealand Government website that is dedicated to biodiversity. Landcare's database can be found at Iris.scinfo.org.nz.

To keep in touch with air quality issues, NIWA is the crown research institute (CRI) most involved with and usually publishes a number of reports each year. Regional councils are responsible for monitoring and managing point source discharges and most provide copies of reports and data showing trends on their websites. For energy-related information both the Ministry of Economic Development (MED) and MfE provide up-to date information. Other useful sources for reports and discussion papers on energy are the PCE. Detailed data relevant to both energy use and air quality can be gathered from Statistics New Zealand, Land Transport New Zealand and Ministry of Transport.

A variety of government land agencies and CRIs are a good source of information for keeping in touch with research and developments on the marine environments and coasts. The main agency for fisheries is the Ministry of Fisheries, although the focus is on fish stocks rather than maritime ecosystems. DoC is assessing the implications of fisheries by-catch. The MfE has some information on oceans and coasts and PCE periodically publishes assessments of management of marine and coastal environments. The main CRI conducting research on marine environment is NIWA. Most regional and district councils publish assessments or specialised reports coastal erosion. Updates on the monetary values and trends over time the fish stock in New Zealand waters is given on a Statistics New Zealand website.

Statistics New Zealand and the PCE provide environmentally relevant data and commentaries. For specialised data, one needs to go directly to specialised agencies, for example: fuel consumption – Ministry of Energy and Trade; water quality indicators and land use and livestock numbers – MAF; wastewater treatment – Ministry of Health; recreational and drinking waterborne diseases – Public Health and Surveillance; vehicle kilometres travelled – Ministry of Transport; and mean age of vehicle fleet – Land Transport New Zealand. DoC publishes New Zealand's official list of endangered species.

10.6.1 Policy

Information on the latest changes in environmental policy can be found on the MfE, MAF, MED and DoC websites. Environmental policy think tanks are a good source of information for keeping in touch with the debate about alternative approaches to environmental management. In the USA, these include the Earth Policy Institute, Resources for the Future, the Worldwatch Institute, the World Resources Institute and the Aspen Institute. In the UK, the Institute for European Environmental Policy, the Institute for Public Policy Research and, from a developing country perspective, the International Institute for Environment and Development. In New Zealand, Motu, an economic and public policy research trust and the Ecologic Foundation conduct and publish research on environmental management options. The Treasury and MfE are sources for government agency thinking about environmental regulation, especially the Treasury working paper series. For debates about the meaning of sustainability with an Australasian focus, the Sustainability Council of New Zealand, Landcare Research and the Sustainable Business Network are good starting points. MED and DoC websites have pages where their latest news releases are posted. These will keep you in touch with latest legal and policy changes and give information on recent environmental issues. The PCE website will keep you posted on its current projects and reaction to already completed reports. Local Government New Zealand is a source for an overview of the issues at the regional council and territorial authority level. Individual regional council environment departments have their own websites; some such as Environment Waikato specifically include a Māori perspective. Landcare research is another organisation with a website giving issues from a Māori point of view. The OECD Environmental Performance Reviews are a useful source of information including an up to date listing of New Zealand's participation in international and regional environmental treaties.

MED is principally responsible for statements about the direction of economic management. In 2006, for example, it introduced the concept of economic transformation as guiding principle for economic management and this includes reference to environmental sustainability as one of the attributes of transformation. MED is also responsible for the country's energy strategy and information about it can also be accessed through the Ministry website. The website is also an entry point for information about international trade and tourism. The MED has periodically conducted a study of New Zealand business practices and performance that includes some aspects of business investment in environmental initiatives. Reports from this ongoing study can be obtained through the Ministry website. The Packaging Council of New Zealand reports annual on progress with the Packaging Accord.

10.6.2 Voluntary Initiatives and Environmental Perspectives

For discussion of voluntary initiatives, organisations that facilitate corporate social responsibility are a source of information, such as the Environmental Defence Fund and Forest and Bird. The Greenhouse Policy Coalition website informs you of the perspectives of a business lobby and provides an up to date commentary of the development of New Zealand's climate change policy. The New Zealand Business Council for Sustainable Development provides information about the latest environmental business initiatives. The Māori Environmental Business Network aims to promote environmentally sustainable practices within Māori and mainstream business. Landcare research gives information relating to Māori environmental values.

For discussion of voluntary initiatives with international links, organisations that facilitate corporate social responsibility are a source of information such as the Environmental Defence Fund in the USA and, in the UK, SustainAbility Ltd. The World Business Council for Sustainable Development is another helpful source with its network of regional offices including New Zealand.

For the perspective on environmental NGOs, the Environment and Conservation Organisations of Aotearoa New Zealand and the Ecologic Foundation are goods websites to visit. The Environmental Defence Society has more specific information on the Resource Management Act. For the perspective of business groups, Federated Farmers, Business New Zealand and the Business Roundtable give a range of commentaries and links to other information.

A sample of campaign and interest groups to keep you informed about what others are thinking includes Federated Farmers, the Business Council for Sustainable Development, the Ecologic Foundation, the Federation of New Zealand Mountain Clubs and Eco. For international perspective the OECD provides material on concepts used in assessing environmental health and international comparisons. Discussion documents and formal publications are available from their websites.

Study Guide

End of Chapter Summary

10.1 Views on the state of the New Zealand environment vary widely. Those that are critical tend to be influenced by comparison between the present and the environment pre settlement; those that are supportive compare New Zealand with other developed countries.

10.2 New environmentalism encourages the fast circulation of ideas and campaigns around environmental issues. The example of local food shows how environmental agendas may not be based on a full assessment of the issues and may not result in the outcomes that some supporters hoped for.

10.3 There are strengths and weaknesses in the current state of the New Zealand environment. The main shortcomings affect the availability of environmental data, the protection of lowland, coastal and ocean ecosystems, pest control techniques and urban air quality.

10.4 The OECD identifies three main areas where prospects for green growth in New Zealand can be strengthened: (i) inadequate governance for sustainable development policy; (ii) too little use of market-based instruments; (iii) insufficient pricing of carbon to address climate change. There is some evidence that New Zealanders value maintaining the quality of the environment over economic growth. To date business has showed too little support for environmental responsibility to justify national branding that the country is clean and green.

10.5 A number of government funding schemes offer support to community environment projects. These can help fill gaps in environmental protection that are not covered by public agencies.

10.6 Changes in environmental policy and the understanding of environmental issues can be monitored by keeping in touch with the information released by public agencies and environmental groups.

Discussion Questions

How is it possible for judgements on the state of the environment to vary as widely as they do?

What changes to New Zealand's environmental management regime would you recommend?

Why is it important for the government to support conservation initiatives on privately owned land?

Do you think local action can make a significant contribution to making New Zealand a more sustainable society than it is at present?

How would you prioritise New Zealand's environmental problems?

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