Environmental markets for New Zealand: the barriers and opportunities

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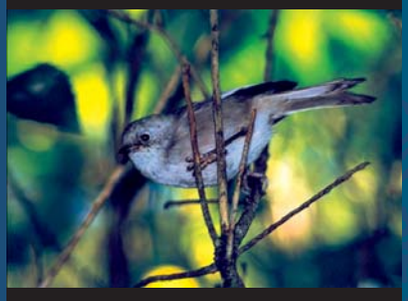

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Executive summary

Natural resource use has intensified, but so has environmental degradation. In attempts to curb degradation and improve environmental quality, and achieve environmental goals at lower economic cost, governments are adopting a wider diversity of policy approaches and instruments. Here we examine one such instrument – environmental markets, which have evolved rapidly since the 1970s and combine regulatory and market-based approaches.

Environmental markets complement regulation by providing flexibility in how regulated sources can meet their regulatory obligations. When a market exists, a regulated source of environmental harm can either reduce its impact or purchase improvements in environmental quality from those that can make improvements at lower cost. In theory, this flexibility should allow environmental goals to be achieved at a lower cost than with regulation alone.

The recent development of markets has been encouraged by the need to include a greater variety of sources of environmental degradation to achieve an environmental goal, especially where stand-alone regulation it is not politically or economically palatable. For example, although agriculture is the largest source of nutrient pollution in many US catchments, there is political unwillingness to regulate agricultural sources. Establishment of an environmental market for nutrient pollutants can make such regulation more palatable for the regulated sources. Not only can agricultural sources benefit financially from selling their low-cost reductions in pollution, but regulated sources can lower their compliance costs by purchasing these lower-cost reductions.

Many now ask if environmental markets are truly successful, and what is needed to establish them. A successful environmental market is one that besides meeting its environmental goal, lowers the compliance costs for the regulated participants, provides incentives to innovate, and lowers regulator costs (administration, monitoring and enforcement). However, environmental markets are not always appropriate, and to be successful they require particular characteristics and conditions:

- Precise legislation or rules comprising unambiguous environmental goals and quantitatively defined caps adequate to meet the goal
- An environmental commodity that can be quantified in an appropriate currency, and a reliable, well-tested measurement and estimation methodology
- Trading restrictions to prohibit exchanges that would cause negative externalities
- Sufficient numbers of buyers and sellers (market participants)
- Sufficient technical or management options to reduce environmental damage (e.g. alternative options to reduce emissions, or water use) and/or possible sites to trade
- Inclusive stakeholder consultation that enables buy-in from the range of interest groups
- Rigorous and credible enforcement
- Robust market design with
    - sound governance, and effective mechanisms for coordination between the different levels of government involved
    - independent market oversight and review
    - certainty for participants (e.g. adequate liability arrangements)
    - appropriate capability and resources, and adequate mechanisms for quality control within the administering agency
    - appropriate infrastructure to minimise transaction costs

We identify a number of barriers to the development of robust and efficient environmental markets in New Zealand:

1. New Zealand's primary environmental legislation, the *Resource Management Act 1991* (RMA), is enabling in principle, but makes market establishment challenging in practice. A key problem is the ambiguity of 'sustainable management', which provides a poor basis for defining environmental goals. There is also inadequate direction on allocation of property rights and the setting of caps, and limited transferability of consents and permits. Further, the RMA provides no guidance on who has authority to establish and operate markets, and has weak accountability for administrative bodies. The RMA devolves most environmental decision-making to regional and district councils. This means varied,

and often limited, capacity to assess the need for an environmental market and then to design, establish, operate, monitor, and enforce it successfully. Capability problems are compounded by deficiencies in cooperation and coordination among central, regional, and local government. Devolution also increases the likelihood of regulatory capture by local economic interests, and makes it more difficult for dispersed stakeholder interests (like environmental non-government organisations) to engage.

2. The political viability of markets is also a problem. Those affected by the proposed underpinning regulation will resist, which affects subsequent market design, often leading to weak environmental goals and less efficient overall market design.

3. A lack of environmental data and the cost of acquiring these are further hindrances to the establishment of environmental markets and to compliance monitoring. Legal constraints on access to private land for inventory and monitoring purposes are likely to be especially problematic for some markets.

4. New Zealand's small size may limit potential participants (limiting market efficiency), and the number of third-party providers for verifying or certifying transaction details and their level of independence (compromising quality control).

Successful environmental markets for New Zealand need:

- Supporting guidance, including
    - Assistance to government and other relevant stakeholders to determine whether environmental markets are an appropriate policy response
    - Development of overarching national market policy and guidance on market design to promote consistency between markets and reduce establishment cost, and identification of compliance mechanisms that market administrators can legally apply
- Legislative amendments, including
    - Amendment of the RMA to
        i. clarify the meaning of 'sustainable management'
        ii. enable councils to formulate precautionary rules and regulations
        iii. overcome limitations on the transferability of consents and permits
        iv. require the Minister for the Environment or territorial authorities and regional councils to specify measurable environmental goals or promulgate new legislation for market operation
        v. create better means for revoking permits for lack of compliance
    - Establishment of an independent oversight committee or ombudsman to act as a grievance body for public oversight concerns with markets, and requiring market administrators to submit annual reports on market performance to that body
    - A requirement that environmental markets be subject to regular independent audits
- Infrastructural development, e.g. a national marketplace, and registry for all markets

Environmental markets will be feasible for some regions and some commodities in New Zealand. Greenhouse gas, water quality and water quantity markets are likely to be the most straightforward, but nevertheless face numerous legal, resource and information constraints.

Biodiversity is problematic. It is too complex to be quantified in an adequate, simple currency, and is very difficult and expensive to measure. Exchanges need extensive restrictions to avoid environmental harm, limiting the availability of biodiversity goods and services and potential traders, and effective enforcement is demanding and may be impractical. Even if these factors were overcome (which may not be possible), establishing a credible biodiversity market would require significant changes in legal, administrative and biodiversity information arrangements.

1. Introduction

Environmental markets are one option in an array of interventions available to policymakers for reducing environmental degradation or improving environmental quality. While markets are not always an appropriate policy response, they are often promoted as a more palatable and cost-effective option for achieving an environmental goal than stand-alone regulation, especially by those regulated. This is because markets can allow greater flexibility to those causing environmental harm in how they meet their regulatory obligations – which may result in cost-savings.

Environmental markets first emerged in the 1970s and have become much more prominent internationally since the mid-1990s. A large number of markets now exist worldwide for a wide range of environmental commodities including water quality, water quantity, carbon, sulphurous and nitrous gases, fish stocks, wetlands, and threatened species. This growing international experience provides a basis for assessing whether, and in what circumstances, environmental markets are truly successful, and what is needed to establish a successful environmental market.

New Zealand was a relatively early adopter of environmental markets. A quota management system for the fishing industry was introduced in 1986, setting catch limits, and those holding a quota could use, lease, buy, sell or transfer their quota. It still operates today. However, there has been relatively little development of additional markets since that time.

In this Science Series report, we ask what is required to establish successful environmental markets in general, and investigate some of the barriers to the development of such markets in New Zealand. Then, we identify some actions that could facilitate the evolution of successful environmental markets for New Zealand. We primarily focus on compliance (i.e. mandatory or regulatory) markets, in particular those for greenhouse gases (GHGs; see also Appendix 1), water quality (Appendix 2), water quantity (Appendix 3) and biodiversity (Appendix 4).

2. Why environmental markets?

Environmental degradation has traditionally been addressed by government-imposed regulation that outlaws or limits certain practices. There are two main forms: (1) technological standards that specify the type of equipment or processes that each industry must adopt, and (2) performance standards that identify an environmental or technical target, but allow flexibility in how targets are achieved (Greenhalgh & Faeth 2001).

If a source of environmental harm (which might be a factory, a farm, another type of company, an organisation, or an individual) fails to comply with prescribed levels of pollution, abatement, or environmental quality, or to adopt the prescribed means of reducing environmental damage, a penalty will be incurred (Opschoor et al. 1994).

A common criticism of these traditional regulatory instruments is that when used alone they can provide a relatively inflexible and inefficient mechanism for achieving a desired environmental outcome. For instance, farms or factories may need to upgrade equipment continually to meet changing technology-based standards, and/or have to discard old, non-compliant appliances and purchase new, more efficient ones. Regulatory enforcement agencies must also keep abreast of new technological advances. Stand-alone regulation is also seen as unlikely to achieve a desired environmental outcome at least cost, because it requires all regulated sources to comply, regardless of differences in compliance costs between sources of different type, size, location and structure. Further, it is pointed out that stand-alone regulation also provides no economic incentive for those regulated to innovate to reduce their environmental effects beyond the specified and enforced standards (Industry Commission 1997; Greenhalgh & Faeth 2001).

Economic instruments supplement or substitute for stand-alone regulation, providing regulated sources with incentives (usually financial) to change their behaviour and thereby reduce their impact on the environment. As Bedar (2006, p. 156) explains, 'Economic instruments do not tell polluters what to do; rather, polluters find it expensive to continue in their old ways. Individuals and firms can use their superior knowledge of their own activities to choose the best way of meeting environmental standards.' There are two categories of economic instruments:

- Price-based, e.g. taxes and subsidies. Taxes place a penalty on those who degrade the environment, while subsidies provide rewards to reduce negative environmental impacts (Greenhalgh & Faeth 2001).
- Market-based (or rights based), which include environmental trading markets. Markets usually create rights to use natural resources or to pollute the environment, up to a predetermined limit, and allow these rights to be traded, providing incentives for those who can cheaply reduce their environmental impact to do so and then sell those improvements to others.

Environmental markets have some key theoretical advantages over stand-alone regulation or price-based economic instruments, especially in efficiency and cost-effectiveness in improving environmental quality and meeting environmental goals (e.g. Tietenburg 2006).

In theory, environmental markets can provide the same or better environmental protection at lower cost to business than regulation. This is because businesses can weigh the marginal costs of reducing impacts against the cost of purchasing reduced impacts elsewhere. Therefore, assuming low compliance, information, and transaction costs, environmental markets should be more efficient than a 'blunt' regulation where the compliance ability and costs of regulated sources differ. Markets encourage efficient resource allocation (improvements are achieved at lowest cost) and technological innovation, while providing flexibility to regulated sources (by selling or buying rights, and in how improvements are achieved). Together these should reduce compliance costs.

Also, in theory, markets may (a) avoid some negative incentives that may accompany regulation, e.g. legislation protecting endangered species may turn species on private land into liabilities, providing landowners with an incentive to 'shoot, shovel and shut up' (Lueck & Michael 2003), and (b) improve equity as they encourage greater internalisation of costs by private parties (i.e. the 'Polluter Pays' Principle).[1]

Markets offer the advantage of enabling regulators to directly specify and control the level of environmental degradation by using regulation to stipulate an environmental cap. Price-based instruments such as subsidies and taxes are unable to specify environmental caps because they rely on the influence of the pricing mechanism to change polluter behaviour.

Notwithstanding their theoretical advantages, in practice there is little empirical evidence to date that market-based instruments have been more efficient or effective than other instruments, and there is much debate in the literature (Gustaffson 1998; Kroeger & Casey 2007). It is also increasingly recognised that environmental markets require particular conditions and characteristics for their theoretical advantages to be realised.

[1] This does not hold for all markets. For example, where polluters receive free allocations of credits, the market follows a '*polluted* pays' principle.

3. Types of environmental markets and their commodities

In this report, we define environmental markets as compliance or voluntary markets that trade environmental commodities and involve multiple exchanges of credits or allowances. Our definition includes markets for greenhouse gases (GHGs), water quality or nutrients, water quantity and biodiversity. Our scope does not include one-off, or few, exchanges (e.g. offsets for ad hoc biodiversity mitigation or compensation conditions), nor do we consider other market-based instruments such as reverse auctions.

Compliance markets

Most environmental markets are compliance markets (alternatively termed mandatory or regulatory markets) created and regulated by mandatory government regulations. Typically, an environmental goal and associated quantitative cap[2] is established by policy, statute or regulation, and the cap is allocated between relevant sources.[3] Sources that reduce their effects, emissions, discharges or abstraction to levels below their allocation may sell any excess credits, permits or allowances. Conversely, those whose effects, emissions or discharges exceed their allocation must either buy credits, permits or allowances from these sellers to cover the excess, or face a penalty.

Compliance biodiversity markets often differ in having a qualitative environmental goal (e.g. to achieve 'no net loss' or a 'net gain' in biodiversity) but no associated measurable and quantitative cap. Instead, biodiversity markets may prohibit certain activities, e.g. indigenous vegetation clearance, species habitat destruction, filling of wetlands, or only allow these activities if an 'offset' sufficient to replace the biodiversity damaged by the activity is purchased.

Voluntary markets

Voluntary[4] environmental markets are typically driven by consumer preferences and are not established or enforced by government.[5] Instead, they usually have policies, rules, and verification and audit procedures intended to protect the reputation of credits and hence public relations benefits to purchasers. The credibility of voluntary markets are variable (see Kollmuss et al. 2008) with some markets developing standards to improve the comparability, consistency and rigour of the trades (e.g. the Voluntary Carbon Standard (VCS 2007) for the generation of voluntary carbon credits; VCS Association 2007).

Commodities and currencies

Environmental markets trade environmental commodities that are often proxies for environmental quality (e.g. nutrients or water temperature in water quality markets). These commodities are quantified in currencies (i.e. tradable units of a commodity, such as kilograms, tonnes, or hectares) (Table 1).

[2] Environmental goals are often qualitative and ambiguous to interpret. Most qualitative goals are accompanied by a quantitative cap.

[3] Caps are usually allocated through the free distribution or auction of tradeable credits, permits or allowances.

[4] We note that the decision to participate in either a compliance or voluntary market is voluntarily. In a compliance market, it is possible to meet the regulatory requirements with or without trading.

[5] For example, a voluntary market for carbon offsets has emerged for those who wish to reap reputational benefit from taking responsibility for their carbon emissions by voluntarily purchasing carbon 'offsets'. These 'offsets' are often bought from retailers or organisations that invest in a portfolio of offset projects and sell slices of resulting emissions reductions to customers in relatively small quantities.

Table 1 Environmental markets, associated commodities and sample currencies and metrics

Market	Commodity	Currency and units (examples)
Water quality	Nutrients Temperature Salt	Kilograms of nitrogen or phosphorus Length of river planted to trees, or increase in water flow Tonnes of salt
Water quantity	Water	Megalitres of water
GHG/carbon	All GHGs	Tonnes of carbon dioxide equivalents (CO_2e)
Sulphur dioxide	Sulphur dioxide	Tonnes of sulphur dioxide (SO_2)
Biodiversity*	Endangered species Habitat (e.g. wetland) Native vegetation	Number of breeding pairs Hectares of habitat Habitat-hectares of a specific vegetation type

*Note that existing biodiversity metrics are generally disputed, and criticised for inadequately representing biodiversity characteristics of concern.

4. Characteristics of successful environmental markets

Not all contexts and environmental issues are amenable to management via environmental markets, and the ability of markets to deliver environmental protection at lower cost than other alternatives varies greatly. Some environmental markets may reduce compliance costs for regulated parties but worsen the environmental problem they address or create new ones. Others might achieve environmental goals without reducing compliance and/or regulatory costs. Therefore, we define a successful environmental market as one that meets its environmental goal as well as:

- Lowering compliance costs for the regulated participants
- Providing regulated participants with incentives to innovate
- Lowering regulator costs (administration, monitoring and enforcement).

Comprehensive *ex post* evaluations of environmental market successes and failures are seldom available. This is partly because many markets have not been operating for long enough to have made significant progress toward their environmental goals.[6] Furthermore, reviews by interested parties may be poor gauges of success; markets will rarely fully satisfy all interests (i.e. public environmental interests, traders, and regulators) and each will identify different weaknesses and amendments. Despite this, there have been some systematic attempts to identify key requirements for successful and well-functioning environmental markets (e.g. Selman et al. 2009[7] for water quality markets), which we describe below.

Clear market drivers

Environmental compliance markets are driven by legislation or regulation that requires sources to improve their environmental performance and provides a trading mechanism to give those sources flexibility in how they comply with the regulation. Market success seems to be linked to highly prescriptive, detailed and carefully thought-through legislation or regulation, which sets an appropriate cap.

[6] For example, water quality in Lake Taupo is expected to decline further despite legislation to control current nutrient inflows and the establishment of a water quality market, because of 80-year groundwater-to-lake inflow lag times.

[7] The elements identified included that (1) adequate drivers exist for pollutant reductions; (2) potential risks to the regulated community are adequately addressed; (3) standardised estimations of non-point-source emissions and reductions are developed; (4) transaction costs within the trading programme are minimised; and (5) programme has buy-in from local government, the regulated community and other stakeholders within the catchment.

Legislation

Successful compliance markets require precise legislation to:

- Establish unambiguous environmental goals for the market to achieve and be monitored against
- Establish the authority for appropriate levels of government to implement markets
- Specify rules or caps that are effective market drivers
- Clarify allocation of property rights that can be enforced and are fully tradeable (Bell & Quiggin 2008)
- Enable effective enforcement of the market. This may include appropriate powers to enforce trading contracts and sanction violations, and avenues for public oversight of both transactions and the administrators' accountability for inadequate application of market rules
- Secure participation by preventing potential participants from circumventing market rules through the use of less demanding and/or more environmentally damaging options[8] that reduce demand for, and hence the value of, tradable allowances or rights

Legislative and regulatory drivers of environmental markets can take two forms:

1. Comprehensive legislation that sets the environmental goal and the market rules. For example, the *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002* in Australia is highly prescriptive. It establishes a quantitative environmental goal,[9] defines the physical boundaries of the Scheme, and sets out the allocation cap, market structure, monitoring protocols and enforcement mechanisms, and market infrastructure (NSW Government 2002). In New Zealand, Variation 5 of the Waikato Regional Plan underpins the Lake Taupo Nitrogen Market in New Zealand and stipulates the water quality cap for lake inflows, how the cap is allocated, the measurement methodology, as well as some trading restrictions.
2. Framework legislation that allows regulations and markets to be separately established is more common than comprehensive legislation. The *Clean Water Act* (CWA) in the US and the Kyoto Protocol are two prominent examples:
    - The CWA is the framework legislation for most US wetland banking programmes. It enables specific goals and operating guidelines for individual programmes to be provided by state regulations and Acts,[10] which vary greatly in scope and detail.[11] The CWA is also the basis for most US water quality markets.[12] Rules and operation of individual markets are governed by either state-wide rules[13] or area-specific regulations or policies that cover market operational elements.[14]
    - The Kyoto Protocol (an international climate change treaty that was fully ratified and effective in 2005) is the basis of most GHG markets. It sets the GHG emissions cap for all Annex I countries (predominantly developed and transitional economies) and stipulates trading restrictions, e.g. the amount of GHG reductions (or credits) able to be purchased from Annex II countries (predominantly developing countries). The specifics of

[8] For example, in the USA, the option of in-lieu-fee mitigation has undermined the market for wetland bank credits (Gardner 2000).

[9] Electrical conductivity (EC) of saline water in a high flow block is not at any stage to exceed the following targets: (a) 600 EC in the upper sector, (b) 900 EC in the middle sector, (c) 900 EC in the lower sector. (Sectors are parts of a catchment, defined by geographic sector reference points.)

[10] In 2002, over 70% of banks were underpinned by separate state-level requirements – 12 states had statutes and regulations, 9 states had only statutes, 2 had only regulations, 8 had only guidelines, and 5 more had either proposed statutes, proposed regulations or draft guidelines (Environmental Law Institute 2002).

[11] For example, the *Sacramento–San Joaquin Valley Wetlands Mitigation Bank Act of 1993* (California Department of Fish and Game 2007) sets out an explicit no-net-loss policy of wetland acreage or habitat, and a goal to increase the total wetland acreage and values. On the other hand, the *Arkansas Wetlands Mitigation Banking Act (1997)* does not explicitly require no net loss, but rather promotes the restoration and conservation of wetlands and the offset of losses of wetland values 'caused by activities which would otherwise comply with state and federal laws' (Arkansas Multi-Agency Wetland Planning Team 2007).

[12] Under Section 404 of the CWA, applicants (to discharge) must provide documentation that there is no practicable alternative to the proposed project and practical steps must be undertaken to minimise all potential adverse effects (Environmental Law Institute 2002).

[13] In 2010, 13 sets of state-wide rules for water quality markets were either in effect or under development in the United States.

[14] One example is the Chatfield Reservoir Trading Programme regulation that establishes a watershed trading programme in Colorado. The regulation states the environmental goal as well as the allocation rules, measurement methods, physical boundaries and eligible participants.

individual (country/region) trading schemes are defined by separate legislation (e.g. Directive 2003/87/EC of the European Parliament that established the EU Emissions Trading Scheme (ETS); the *Climate Change Response (Emissions Trading) Act* that established the New Zealand ETS).

Voluntary markets do not have underpinning legislation. Instead, individual programmes define their own targets and operating rules. In the Chicago Climate Exchange (CCX), for example, companies accept voluntary GHG reduction targets that can be achieved internally or by purchasing credits from other CCX companies or from approved external projects. Voluntary markets appear to have more relaxed requirements for meeting environmental goals than most compliance markets, and the integrity of voluntary programmes is sometimes questioned; especially whether approved external projects meet credible additionality[15] criteria. Regardless, voluntary markets appear to have more relaxed requirements for meeting environmental goals than most compliance markets.

Caps

If a market is to trade actively, it is essential that the cap is set at an appropriate level. Caps can be too high or too low for active trading, and in some cases a market fails because a cap is not set at all.[16]

In practice, at least four factors influence the setting of a cap (Bedar 2006): environmental quality, technological capability, national and regional economic considerations, and politics (especially the influence of vested interests). The latter two factors often prevail, because governments are usually concerned about international competitiveness, and businesses can successfully argue for caps that enable increased emissions or require no reductions to be made.[17] Where regulatory caps have been too generous, markets have experienced little trading, allowances have had little value, and have been mainly purchased cheaply by new additional polluters. Accordingly there has been little environmental improvement.

Markets with more stringent environmental goals and caps have tended to trade more actively. For example, water quality markets in the US Chesapeake Bay states (Virginia, Maryland, Pennsylvania and West Virginia) were developed in conjunction with water quality standards that were translated into nutrient limits in point-source (i.e. sewage treatment plant) discharge permits. This provided a clear basis for trading.

Markets encourage reductions in environmental harm by those sources that can do so at lowest cost, and Bedar (2006) argues that markets have worked best where a cap can be set at a level that requires only the cheapest reductions to be made. A market may not be appropriate where substantial reductions[18] (and hence very stringent caps) are needed to meet environmental quality goals, and where all sources need to reduce their emissions dramatically and install new plant and equipment. In such cases markets may serve only as interim cost-saving mechanisms that allow businesses short-term flexibility in scheduling their equipment upgrades, because in the medium and long term there may be too few allowances available in such a market to provide scope for trading.

[15] To be 'additional' traded credits must be beyond 'business as usual'. Determining additionality entails forecasting (deducing a person's rationale for undertaking an action and whether that action would have occurred in the absence of the programme), which is inherently uncertain. For example, to achieve its environmental goal, a biodiversity market must be capable of discerning whether a restoration project would have gone ahead and/or whether a forest patch just covenanted is under realistic threat of clearance or would have endured regardless.

[16] For example, The Lower Boise River Effluent Trading Demonstration Project, a water quality market in the US that was developed and finalised in 2002 in anticipation of a regulated total maximum daily load (TMDL), has experienced no trading as the TMDL has not materialised.

[17] Examples include caps in EU countries when the ETS was introduced in 2005 (ILEX Energy Consulting 2005; Pearce 2005) and British allocations to industrial sectors in 2005 (Lohmann 2004; Pearce 2005).

[18] For example in Germany, where the goal was a 90% reduction in SO_2 emissions from 1983 to 1998 (Schärer 1999, pp. 144–145).

Adequate currencies, measurement, and exchange restrictions

In any environmental market, it is important that the environmental commodity can be easily and accurately measured (Salzman & Ruhl 2000). Where measurement is inaccurate, or there is uncertainty in estimation, a market may not meet its environmental goal, and the integrity and reputation of credits is compromised. If measurement is difficult or costly, this will place a heavy burden of validity assessment on regulators, and slow the trade approval process.

Simplicity and measurability of the commodity

Commodities traded in environmental markets cover a continuum from simple, readily measurable commodities such as air pollutants to complex commodities such as biodiversity, which pose the greatest measurability problems (Fig. 1). At one end of the continuum, GHG markets trade relatively simple commodities (gaseous pollutants) that have simple currencies (e.g. tonnes CO2e) that are fairly easy to measure and a relatively good proxy for climate-changing emissions anywhere, regardless of the type or place of source. At the other extreme, biodiversity is highly complex and hierarchical, and cannot be quantified in an adequate, simple currency.19

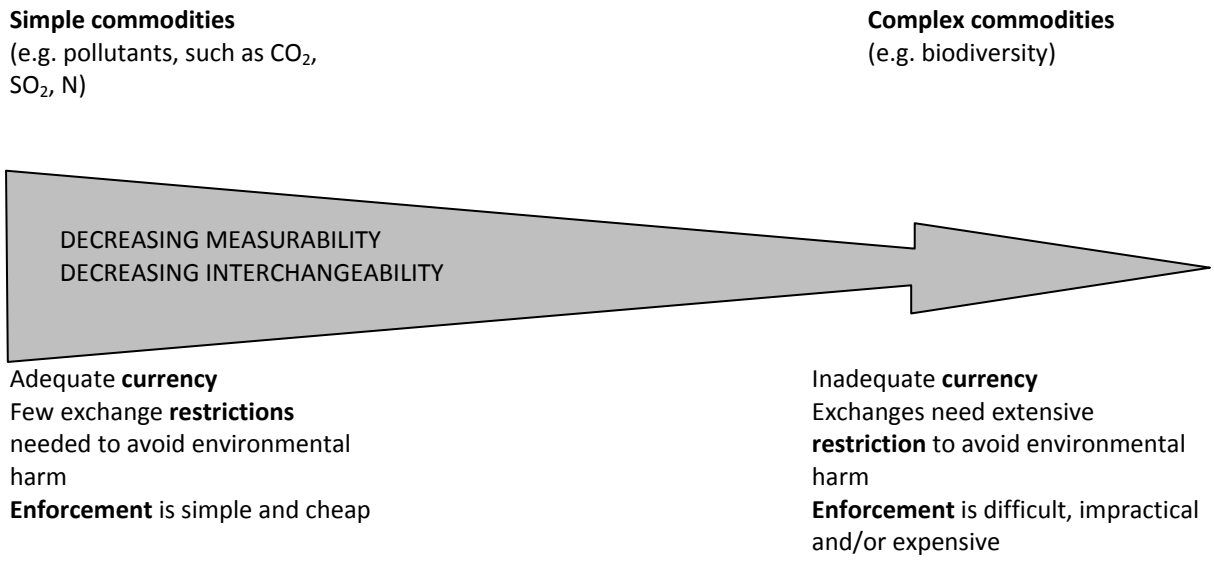

Fig. 1 Effects of commodity simplicity on currency adequacy, requirements for exchange restrictions, and practicality of enforcement in an environmental market.

[19] For example, a newly created wetland may be the same size as a wetland lost to development, but may not support the same suite of species, nor provide the same ecosystem services (e.g. flood or sedimentation control) and the same set of ecological functions (e.g. species breeding or feeding habitat) as that lost. Biodiversity composition, structure, services and functions are exceptionally difficult to measure and compare.

Even with simple environmental commodities, measurement of quantities traded and their contribution to an environmental goal may range from relatively straightforward and reliable (GHG point sources) to very difficult and inherently uncertain (e.g. modelling and estimating groundwater –surface water interactions; see Gunningham 2008).

To promote measurement consistency, some environmental markets have rules that stipulate either the methodology for measurement or a particular estimation tool (e.g. where it is not possible to directly measure discharges, as in diffuse (non-point) pollution markets). For example, the Lake Taupo Nitrogen Market will use the Overseer® nutrient budgeting tool to estimate agricultural nitrogen losses, and the Pennsylvania Water Quality Trading Programme uses standardised agricultural nutrient discharge calculation sheets. The Clean Development Mechanism (CDM) of the Kyoto Protocol has a list of approved methodologies for estimating GHG reductions from projects.[20] We note that while specified measurement methodologies may promote consistency, they cannot always guarantee accurate quantification, and could also lock in systematic assessment errors that compromise the environmental goal.

In some environmental markets, uncertainty of measurement is compounded by the need to determine additionality.[21] Additionality is inherently difficult to assess and to prove, because it entails forecasting (i.e. deducing participants' rationale for undertaking an action and whether that action would have occurred in the absence of the programme). If an assessment is incorrect, and credits are granted to actions or projects that are *not* additional (i.e. that would have gone ahead anyway), the environmental goal of a market will not be achieved.

Interchangeability, externalities, exchange restrictions, and policing

Complex environmental commodities often vary in *type*, *space* and *time* in important ways (e.g. one hectare of wetland of one type in one place is not interchangeable with another hectare of another type elsewhere). Where a currency (e.g. hectares of wetland) does not capture this variability, additional market rules are needed to ensure equivalency in any exchange, and quality control is more difficult (Fig. 1). For example, in wetland exchanges, rules stipulating provision of the same multiple services and functions may be required, as well as detailed scientific investigation to establish equivalence. Exchange restrictions (especially complex ones) are likely to constrain the supply of goods to markets. For example, few wetlands that faithfully replicate the mix and quantum of composition, service and function of the lost wetland are likely to be available for exchange. Furthermore, it is difficult and expensive for regulators to confidently establish equivalence in the aspects of composition, service and function deemed to matter, and to enforce their replacement. Effective policing of a market becomes more difficult as the complexity of the commodity increases.

While biodiversity is likely the most complex environmental commodity, units of even outwardly simple commodities may not be fully equivalent or interchangeable. One example is the volatile organic compounds (VOCs, an air pollutant) traded under California's Rule 1610. This programme, which trades VOC reduction credits, fails to distinguish the many *types* of VOCs emitted. Therefore, less-carcinogenic VOCs (car emissions) can be exchanged for more-carcinogenic VOCs (benzene-containing refinery emissions), leading to a net decrease in VOCs (programme goal) but a net increase in potentially harmful carcinogens.[22] Non-equivalence in *space* in this programme means geographically diffuse VOC emissions (from cars) can be exchanged for geographically concentrated refinery emissions, with severe impacts on certain local communities.

[20] This is proving time-consuming and expensive, because each methodology must go through a separate approval process, and many situations are so specific that the methodology is unlikely to be used again.

[21] For example, with the Kyoto Protocol's Joint Implementation (JI) and Clean Development Mechanism (CDM), polluters purchase emissions reductions in other countries that are supposed to be additional to what would otherwise have occurred. To achieve its environmental goal, the market must be capable of discerning whether the reduction project that gets credits would have gone ahead without the programme. There are opportunities and incentives for governments and businesses in these other countries to hold back climate-friendly policies they would ordinarily implement in order to get paid for undertaking them.

[22] A similar problem arises in GHG trading. Article 5(3) of the Kyoto Protocol relies on the use of global warming potentials to convert all GHGs into a common currency: carbon dioxide equivalents. Each of the gases has different monitoring requirements and, as a result, different enforcement uncertainties associated with it (e.g. much more is known about sources and emissions of hydrofluorocarbons than about methane).

Finally, non-equivalence in *time* can lead to relatively dilute car emissions that rise and fall in regular and predictable patterns being exchanged for concentrated VOC refinery emission spikes at irregular times (again potentially affecting local communities close to the refinery). In general, the inability of a currency to account for important differences in type, space and time leads to negative 'externalities', which are a common form of market failure.

Sufficient number of traders and trading options

Environmental markets are usually 'thin' (i.e. have few traders), and at some point the number of traders (buyers and sellers) become too few to justify the costs of market establishment and administration. Markets are typically thin because of the geographical scale of the market or the low number of eligible participants.

For example:

- The US Acid Rain Program (Phase I) began in 1995 and covered about 110 electrical generating plants in 21 states.
- The Long Island Sound Nitrogen Trading Program covers 79 publicly owned treatment works in Connecticut (Connecticut DEP 2003).
- US wetland mitigation programmes in 2005 had an estimated 450 approved banks (covering one or more sites), of which 59 had sold out of credits (US EPA 2009).
- In 2005 US Conservation banks for endangered species (operating since the mid-1990s) had just 35 'official' banks, cumulatively covering 15 987 ha and sheltering around 22 species listed under the US Endangered Species Act (Fox & Nino-Murcia 2005).
- The EU Emissions Trading Scheme covers 25 EU member states with approximately 11 500 emissions sources (mainly high-energy-consuming power generation or manufacturing facilities) who are potential market participants (European Communities 2005). As the sphere of influence of GHG markets can be global, they are expected to be bigger and potentially more fluid than most other environmental markets.

Other reasons why environmental markets may be thin are: (a) close restrictions on the type, time or place of trading are needed to protect the environment or (b) few technical or management options exist to reduce environmental harm. Where markets are too thin, other instruments are likely to be more appropriate.

Stakeholder participation and support

The political viability of markets and subsequent participation in them is often tied to the degree of stakeholder involvement and buy-in to market design. Inclusive design processes create confidence and trust among stakeholders.

The degree of stakeholder engagement between markets appears to vary greatly:

- The NSW Biobanking scheme in Australia was criticised for inadequate stakeholder inclusion during its development[23] (Environment Liaison Office 2006). Individual local governments are still unsure about their role even though they seem to play a key part – e.g. biodiversity certification, identifying offsets, and potentially supplying land for offsets – and are likely to have significant capacity limitations. Landowners, who were intended to supply land, were also largely excluded from the stakeholder process (Scanlon 2007).
- US conservation banking guidance development was criticised because it failed to invite public comment. The new policy, which was ambiguous or unclear in a number of places, could have benefited from outside scrutiny (Environmental Defence 2003).
- The Hunter River Salinity Trading Scheme in Australia has an operations committee that oversees the scheme, with representatives from all interested and affected parties (government, licence holders, irrigators, environmentalists, and river management stakeholders). It is meeting its environmental goal.
- The Pennsylvania Water Quality Trading Program in the US held bimonthly meetings for two years with individual sewage treatment plants (regulated sources), the sewage treatment plant association, farm association (Pennsylvania Farm Bureau), individual farmers, conservation districts, environmental groups, the state Department of Environmental Quality, and academics. This allowed disparate stakeholders to come to a consensus on most aspects of programme design and operation.

Coordination between levels of government

Successful environmental markets typically require participation by different levels of government, and hence good relationships among those levels. Greater centralisation of rule development, market design and infrastructure is needed to:

- Reduce the costs of establishing and operating environmental markets (e.g. less 'reinventing the wheel' for measurement methodologies, market infrastructure, etc.)
- Reduce the potential for regulatory capture and non-enforcement (by enabling dispersed interests to better prevail against concentrated local economic interests)
- Improve consistency[24]

Engagement at local level is also often needed, however, to build productive stakeholder support for the market and to access relevant knowledge at a level of detail and scale appropriate to the environmental problem, allowing market rules to be appropriately customised to specific locations (Bell & Quiggin 2008; Gunningham 2008).

[23] Most participation was from the Department of Environment and Climate Change, Total Environment Centre, NSW Farmers Association, NSW Defenders Office, Property Council of Australia, Urban Development Institute of Australia (NSW), NSW Mineral Council, Catchment Authority Management Chairs Council, Local Government and Shires Association of NSW, and Rural Kiama (local lobby group).

[24] Consistency could considerably reduce the cost of establishing markets in different regions in New Zealand. But as with other forms of regulation, consistency is not always an advantage. For example, centrally determined caps and rules that might be achievable for less environmentally competent and proactive councils can potentially undermine aspirations of more skilled and proactive councils.

Effective governance and oversight

Environmental market administrators and regulators shoulder a heavy enforcement burden because, unlike traders of private goods, traders in public environmental goods or services have few incentives to control quality. As long as a permit or payment is forthcoming, traders in environmental commodities gain little additional benefit from monitoring environmental quality (benefits from public goods are diffuse and non-exclusive) and so derive little from having rigorous, precise and independent measurement, robust exchange restrictions, or meaningful oversight and enforcement.

Simple inexpensive currencies, rapid measurement, and limited exchange restrictions, review and enforcement are also desirable for market administrators and brokers, because they are cheap, offer flexibility, and do not impede exchanges (Pedersen 1994; Salzman & Ruhl 2000). This alignment of incentives for traders and administrators means an environmental market may work against environmental protection, and strong oversight is needed to constrain administrative discretion. This is especially problematic in markets with poorly measurable or complex commodities where technical measurement difficulties, and hence enforcement costs, are highest (e.g. biodiversity – Salzman & Ruhl 2000; water quantity – Bell & Quiggin 2008).

A design of effective and inclusive oversight institutions for environmental markets is an unresolved and often unrecognised challenge internationally (Salzman & Ruhl 2000; Bell & Quiggin 2008). An effective governance body must have legitimacy (buy-in from all interests), and both the authority and resources required to govern. Its roles and responsibilities may include setting and adjusting trading rules, oversight and sanction of the administering agency or body, an interest in the cumulative effect of trading on the environment, and the ability to overturn exchanges that compromise markets goals.

Effective administration

Environmental market administration entails providing information, facilitating and ensuring coordination among participants, monitoring, adjudication, administering and enforcing liability arrangements, imposing penalties for defaulting, and managing risk. The requirements for administrative competence include (legislative) authority; fiscal resources; technical (environmental, planning, market) expertise, including modelling, data and research capabilities; policy depth and sophistication; and social skills (including the ability to build and maintain relationships with a variety of stakeholders). Administrative failure with markets can most often be attributed to insufficient institutional expertise, capacity, data deficiency, and failed stakeholder relationships.

A key administrative role is preserving the quality of trades, typically through enforcement, liability rules, and verification/certification procedures.

Enforcement

Successful markets enforce compliance with rules/regulation (compliance markets) or programme rules/targets (voluntary markets). In compliance markets, if the administering agency is different from the regulatory agency, it needs to have sufficient authority to enforce compliance with market rules and/or the regulation.

Enforcement needs to be effective and timely. Unless all parties comply with their allocated caps, and all trades allow participants to stay in compliance, prices may become distorted and the market may not meet its environmental goal. Markets often rely on the same mechanisms as used to enforce a stand-alone regulation (e.g. conditions of individual regulatory permits).[25] The difference for a market is that additional trade information must also be monitored and audited. Financial penalties are the most common form of sanction. For example, permit violators in the US Acid Rain Program face a set monetary fine per tonne of excess sulphur dioxide or nitrogen oxides emitted.[26]

[25] For example, US water quality markets use the existing enforcement mechanisms within the National Pollutant Discharge Elimination System (NPDES), which regulates point sources; and resource consents are the basis for enforcement in the Lake Taupo Nitrogen Market.

[26] In 1998, the Acid Rain Penalty was US$2,581 per excess tonne of sulphur dioxide or nitrogen oxides emitted.

Simplicity and cost-effectiveness of enforcement, regulator capability and resources, and willingness to police the market, are likely key determinants of effective enforcement.

Liability arrangements

Liability arrangements assist enforcement by identifying the parties responsible for meeting the regulation (and who will thus face enforcement action). How liability is assigned in an environmental market can affect participation, and is especially important where there are non-regulated participants. Where the buyers are liable, they may be reluctant to risk purchasing credits from non-regulated sellers who may default. Where the sellers are liable, non-regulated sellers will be more cautious about entering a market. Brokers, who effectively assume liability and have strategies to ensure credit delivery, can facilitate participation as buyers have greater confidence that trades will not default and sellers have less fear of repercussions from non-delivery due to unexpected events.

In US wetland banking, mitigation bankers must (in theory) invest and meet performance standards before credits can be released for sale. As an alternative, in-lieu-fee credits[27] can be sold before a mitigation site is even identified. These fees are attractive for developers as they are cheaper than mitigation bank credits and transfer liability from the developer to the in-lieu-fee programme. However, mitigation wetlands promised by in-lieu-fee credit providers often fail to materialise; tracking data were 'unavailable or incomplete' for 45% of the US in-lieu-fee programmes (Environmental Law Institute 2002). If the permittee remained responsible for the mitigation, performance of in-lieu-fee programmes might improve and the cost of mitigation be more accurately priced (Gardner 2007).

Liability decisions inevitably involve trade-offs between risk and participation. Successful markets where liability may be an issue (e.g. where non-regulated sources are allowed to trade) require special conditions. They weigh trade-offs and incorporate elements into their design to preserve the environmental goal while allowing liability to be transferred away from the regulated source, such as use of brokers, aggregators or middlemen in the system, creation of credit reserves, and providing reconciliation periods that allow regulated sources time to purchase additional credits related to any shortfalls before penalties are imposed.

Verification and certification procedures

To maintain the quality of traded goods (e.g. credits) environmental markets often use third-party certification and/or verification procedures to assess the reliability and value of these. Such procedures verify or certify against a standard, or audit the data and calculations used to quantify the environmental effects. Each market decides what standards (if any) or what audit requirements they will use to ensure that credible commodities are being traded, and, often, select which organisations can act as third-party auditors or verifiers.

Infrastructure to minimise transaction costs

Most environmental markets have developed systems or 'infrastructure' to link buyers and sellers and streamline trading transactions to lower costs. The most common infrastructural developments are (a)

[27] In-lieu-fee credits are when permittees provide funds to an in-lieu-fee sponsor instead of completing project-specific mitigation or purchasing credits from an approved mitigation bank. The sponsor then uses the funds to create sites to satisfy the permittees' required mitigation. Therefore, mitigation is conducted after permitted impacts have occurred (US Department of the Army, US Environmental Protection Agency, US Department of the Interior, and US Department of Commerce 2000).

marketplaces to facilitate transactions and (b) registries that register all transactions and hold ancillary data.

Marketplaces take many forms, but all are designed to streamline the trading process. Clearinghouses[28] (e.g. Long Island Sound Trading Program, Connecticut), auctions/exchanges[29] (e.g. Hunter River Salinity Trading Scheme, Chesapeake Bay water quality markets, European Climate Exchange) and brokerages (e.g. US Acid Rain Program) are different types of market structures that have emerged.

Registries increase transparency and monitor trades to ensure that credits and allowances are not used more than once. They register units for sale and transfer sold units to a buyer's account, thus cancelling units from a seller's account.

5. Barriers to environmental markets for New Zealand

Environmental markets are in their infancy in New Zealand. Using the features of successful environmental markets as a framework, we now describe eight barriers to market development: (1) legislation, (2) information and measurement technologies, (3) market participation, (4) interest-group buy-in, (5) coordination between levels of government, (6) governance and oversight (7), administrative capability and resources, and (8) market infrastructure. We give examples of where and how these may affect environmental markets in New Zealand.

Legislation

The Resource Management Act 1991

The primary legislation for the management of land, water, soil and air in New Zealand is the *Resource Management Act 1991* and accumulated legal decisions.[30] The RMA is an enabling statute, which manages the effects of activities rather than regulating the activities themselves.

Section 24(h) requires the Minister for the Environment to consider the use of economic instruments to achieve the purposes of the Act. However, the Act offers no guidance regarding authorisation to set up and operate markets. Guerin (2003) suggested that it did not provide explicit and sufficient authority for regional authorities to develop market-based instruments. Several possible impediments within the RMA may explain the limited development of environmental markets in New Zealand. These include:

- The RMA purpose of 'sustainable management' provides little basis for goal definition, cap setting or achievement monitoring because it is ambiguous and not objectively measurable.
- Proposed or operational market rules may be challenged because the Court has discretion to determine what constitutes 'sustainable management' under the RMA. Sustainable management is open to a wide range of interpretations involving various trade-offs between the environment and social or economic goals (Skelton & Memon 2002). Moreover, the RMA

[28] A clearinghouse is a single intermediary linking multiple buyers and sellers of credits. The clearinghouse converts a commodity that may have a variable price into a uniformly priced commodity. There is no direct contact between buyers and sellers.

[29] In an exchange, buyers and sellers meet in a public forum (e.g. online) with all commodities being equivalent and all prices variable but transparent. Exchanges are characterised by their open information structure and fluid transactions between buyers and sellers.

[30] Although broad, the RMA is not fully inclusive. For example, the *Hazardous Substances and New Organisms Act 1996* replaced the hazardous substances section of the RMA: harvesting of marine stocks is regulated under the *Fisheries Act 1996*; logging of indigenous forests on private land is regulated under the *Forests Act 1949*; and marine pollution from ships and offshore structures is regulated under the *Maritime Transport Act 1994*. Land use rules do not apply to activities on land held or managed under the *Conservation Act 1987* unless there are 'significant adverse effect[s]' beyond public conservation land boundaries.

enables consideration of a wide range of relevant matters when granting consents (Section 104(1) (c)), which might include ad hoc mitigation measures offered by an applicant (Christensen 2008). The Court may undermine a market by applying consent standards that meet its own definition of sustainable management but are different to market rules, and weaker with respect to the environment.

- Creating effective market drivers is difficult because:
    - The allocation of property rights is inadequate, in that consents and permits may be too uncertain and transient for a viable market. The focus of the RMA is on controlling effects, and it was not designed to clarify and allocate property rights (and hence enable trading). Although RMA permits and consents do have features akin to property rights (e.g. water take permits may get capitalised into land price), the RMA explicitly eschews property rights (Section 122), stating that 'consents are not real or personal property'. Regional and district plans do not need to define precisely the rights associated with a consent or permit. They are regularly reviewed, and plan alterations can and do change consent or permit allocations without compensating holders.
    - There is inadequate capacity to set caps. The Court has developed a principle of priority in interpreting the RMA, with the first-come first-served legal precedent (mostly in cases relating to allocation of water and coastal space) hindering retrospective cap establishment. The *Resource Management Amendment Act 2005* clarifies regional councils' functions to include establishing rules in a regional plan to allocate certain natural resources (including water) and that a plan can allocate resources among competing uses. However, importantly, it does not specify any principles for allocation.
    - There is limited transferability of consents and permits. Consents and permits attach to an applicant, and in some cases to the land. They are not, in general, transferable between activities or locations, although permits to take water or to discharge can be transferred to other sites if allowed in the plan and approved by the council (Sections 135, 136 & 137; there are different limits for different permit types).
    - Accountability provisions are weak. As with other New Zealand legislation, the RMA provides few means to hold decision-makers accountable (e.g. for citizens to take councils to court for not enforcing plans or regulations),[31] which would help to encourage enforcement of market rules.

Therefore, while the RMA allows economic instruments in theory, it seems to limit their use in practice. Nevertheless, legal opinion (Rive et al. 2008) and a court interim decision (EC A123/2008) for Variation 5 of the Waikato Regional Plan demonstrate that environmental markets can be established under the RMA (see Appendix 2 for more details).

Devolution

The RMA's devolution of most environmental decision making to local government (regional and district councils and unitary authorities)[32] has advantages and disadvantages for market development.

On the positive side, catchments and districts may be the most appropriate scale for a market and for accessing relevant information, and for building stakeholder relationships. However, devolved environmental governance also has many drawbacks:

- Variable and often limited capacity and capability in environmental management within New Zealand's regional and district councils, including fiscal resources, policy depth, data,

[31] For example, in New Zealand there is nothing equivalent to the US's *Administrative Procedure Act 1946*. Under this Act, individuals and organisations may sue public as well as private organisations alleged to be in violation of an environmental law or rule. This provides an important incentive for public agents to enforce those laws and rules.

[32] See Kerr et al. (1998). Decisions about (a) land use are made at lowest level (territorial authority, i.e. district council or unitary authority); (b) fresh water, soil conservation and air pollution are made at regional council level; and (c) coastal and marine resource use and protection are shared between the national and regional levels. No person may use land in a manner that contravenes a rule in a district plan, and discharge of contaminants into water or air, or onto land must be 'expressly allowed' by regional council rules or consents. Central government can intervene (through a call-in procedure) only where consent is sought for a proposal of national significance. Plans and resource consents (or permits) are the principal tools of the RMA. Activities fall into six categories, according to rules in regional and district plans. Resource consents (permits) may not be granted for prohibited activities; permitted activities require no resource consent; and the remaining four categories of activities (controlled, restricted, discretionary, and non-complying) require resource consent.

research and administrative capacity, and expertise. This will hinder the establishment and administration of markets, which require substantial agency proficiency and oversight
- Increased need for well-designed market governance, which may require specific legal authority
- Challenges in achieving consistency between jurisdictions, compromising compliance with national goals or international commitments
- More focused power in local economic sector interest groups making regulatory capture more likely. This occurs because:
    - There is greater sectoral concentration in smaller economies and small-group domination by economic interests
    - Effective participation by dispersed interests (environmental non-government organisations (ENGOs) and other environmental interests arguing for public goods and without a monetary stake in the outcome) is hampered as it is more costly and less feasible for them to marshal resources to represent their concerns across many jurisdictions

Local markets are therefore more likely to satisfy one or a few community interests (especially the economically powerful) rather than wider social and environmental interests (Sharp 2002, pp. 27–29).

Legislation governing Crown land

Where Crown (or public) land and resources are involved, legal barriers to environmental markets are potentially greater as there is additional governing legislation, and markets must be compatible with the public purposes for which the land is held. The inclusion of Crown (or public) land and resources in markets can itself present barriers to market development if, for example, the Crown's participation suppresses or skews commodity prices.

Information and measurement methodologies

Successful markets depend on 'sufficient' and evenly accessible information.[33] A normal microeconomic assumption is that information costs are negligible. However, relative to private market commodities, information on environmental characteristics is often scant, and environmental measurement and estimation can be difficult and costly, reducing market viability. Information and measurement barriers for markets in New Zealand range from surmountable to probably intractable.

Resources and economies of scale

New Zealand's technical and financial capacity to gather environmental information and develop measurement and forecasting techniques is constrained by its small size. Councils' resources and commitment to monitoring and managing environmental effects vary greatly, with smaller, rural-dominated councils generally retaining less environmental expertise and allocating fewer resources to environmental functions than larger, more urban councils (also see the section on administration below). It is not that technical capacity is missing in New Zealand (although it is limited), but rather that the capacity is mainly located in Crown Research Institutes, universities and private research organisations rather than in councils and government departments where it is most needed.

[33] More specifically, this information is between traders about goods, terms of trade, and opportunities to trade (e.g. Gustaffson 1998).

Access to collect information

New Zealand's property rights arrangements limit access by public officials to collect environmental information from private and some categories of Crown land (about 70% of all land in total). This increases the cost of information and/or limits the feasibility of establishing environmental markets. For example, access to private property for biodiversity surveys or inventories may be (and often is) refused (see also section below and Appendix 4).

Market participation

Markets requiring close restrictions on type, space or time to protect the environment may be too thin to warrant the cost of establishing and administering a market. For example, a small catchment containing only a few farming families is unlikely to justify a water quantity or quality market. Given New Zealand's small land area, the potentially low level of market participation will always be a concern for environmental markets.

Interest group buy-in (political viability)

Politics plays an important role in determining the structure and performance of environmental markets (Foster & Hahn 1995; Gustafsson 1998), and a strong political mandate is needed to establish markets, especially compliance markets.

Compliance markets depend on underpinning regulations that restrict the use of (or impact on) land, water, air or biodiversity. Because previously unconstrained actions are now constrained, new regulations are typically opposed. Even though markets can make regulation more palatable to regulated sources, the regulation itself may not be viable due to overriding political considerations such as decreased international competitiveness (see Greenhalgh et al. 2007b) or undesirable distribution effects[34] (Bressers & Huitema 2000).

The fiscal costs of complying with a regulation are immediate and concentrated on a few economic interests, while environmental benefits are long term and dispersed. Concentrated (though often less numerous) private and economically motivated interests have more effective influence on the political process than more diffuse public interests such as ENGOs (Olson 1965; Eskridge 1988; McFarland 2004), and this is greatest in smaller economies (e.g. in local government, where most environmental markets are likely to be developed).

Taken together, these factors suggest that in New Zealand:

- Market establishment may be successfully resisted by those whose economic interests are compromised by the underpinning regulation[35]
- Political barriers to markets may be fewer in more populous and urbanised regions and districts that are less likely to be dominated by economic interests[36]
- Markets may more readily be established if all stakeholders agree that the issue is of concern, if there is prominent international, national or local disquiet and hence political mobilisation, and/or where public subsidy deflects the full costs from private economic interests

[34] Distribution effects here refer to how the costs and benefits of a policy instrument are allocated among affected parties.

[35] For example, industries have successfully lobbied for delays in their obligations under the NZETS, based on considerations of international competitiveness, e.g. entry of agriculture in 2015 rather than 2012 as originally stated and extending the phase-out period for free allocation (see also Appendix 1).

[36] For example, representatives of agricultural water users have traditionally dominated Environment Canterbury (regional council) and have every incentive to oppose introduction of meters and markets for water. This is because their water is currently free (apart from the cost of a consent) and take is effectively unlimited (Gunningham 2008, p. 26). More numerous Christchurch City urban residents gain little benefit and bear most of the environmental and fiscal costs of this water allocation policy.

Coordination between levels of government

There are deficiencies in cooperation and coordination between central, regional and local levels of environmental government in New Zealand (Bührs 2002; PCE 2002); both horizontally between different regional and district councils, and vertically between national agencies (e.g. Local Government New Zealand (LGNZ) and the Ministry for the Environment (MfE)) and regional authorities. These deficiencies may limit the transfer of knowledge and experience about environmental markets, and result in poor consistency and increased costs of establishment and operation, because development of measurement methodologies and market infrastructure (and associated costs) are duplicated in different local governments. Lack of vertical coordination also raises the potential for regulatory capture and non-enforcement.

Governance and oversight

At present there is no institution existing in New Zealand that could provide the inclusive and powerful oversight required for successful environmental markets. Such an institutional authority would need legitimacy (representation of, and buy-in from, all relevant interests) and both the legal authority and resources required to effectively govern. Neither traders nor regulators are likely to relish such oversight.

Administrative capability and resources

As noted in our discussion of devolution in legislation (above), the capability and resources of many local government authorities are probably too limited to successfully establish, operate and enforce environmental markets.

New Zealand also faces challenges in ensuring the quality of market transactions. Markets require that administrators are empowered to make timely enforcement decisions to ensure compliance. However, enforcement of permits in many district and regional jurisdictions is slow and weak (e.g. violations may be reviewed by elected councillors before any compliance action) and levels of compliance with permit conditions may be very low. Furthermore, even though the RMA allows any person to raise issues related to the action or lack of it by councils in relation to consent (or other) enforcement, it is, in practice, prohibitively expensive and seldom pursued unless an individual or organisation has both a strong interest in the outcome and substantial resources. Therefore, the avenues to ensure compliance in markets are limited in reality.

Quality control in many environmental markets relies on verification or certification of the commodities traded. However, New Zealand's size means the range of third-party providers is limited and the level of independence in verification or certification processes may therefore be questionable.

Market infrastructure

Examples of market infrastructure (both marketplaces and registries) already exist in New Zealand. The two main remaining challenges for registries in New Zealand are:

- Establishing and communicating the authenticity of transactions (e.g. through transparent criteria and accountability mechanisms such as verification and reporting processes)
- Aligning registries with existing consent databases for markets that operate using resource consents

6. Facilitating the development of environmental markets in New Zealand

Developments in three key areas (supporting guidance, legislative amendments, and infrastructure) may assist the establishment of successful environmental markets in New Zealand.

Supporting guidance

Supporting guidance is required in two key areas: appropriateness and establishment of markets.

1. Appropriateness of markets

Markets are a not always an appropriate policy response to an environmental problem. It would be valuable for guidance to be formulated to assist government, industry and communities to determine whether a market is an appropriate and viable policy response. The preconditions for markets listed in such guidance would, at a minimum, be:

- Commodities are simple and readily measurable, and have a currency that represents 'what we care about'
- The market is underpinned by an unambiguous statutory or regulatory goal that can be quantitatively defined
- An explicit and measurable quantitative cap can be set by regulation
- Pollutant (e.g. nitrogen) units are interchangeable in time or space within a specified area
- Markets are flexible
- Sufficient buyers and sellers exist for a market to operate cost-effectively
- There exist sufficient technical or management options to reduce environmental damage or enhance environmental conditions, or possible sites that can be traded
- Administering agencies are sufficiently empowered and have the capacity to ensure timely compliance and enforcement processes and decisions
- An inclusive and authoritative oversight institution is established
- Individuals and organisations with a clear interest in market outcomes do not need substantial resources to pursue effective market implementation and enforcement
- The available pool of third-party verification or certification providers is large enough to provide assurance of independence from market participants

2. Establishment of markets

National guidance that standardises policy and establishment procedures for environmental markets could considerably reduce agencies' costs and capability requirements. If a general market framework and rules for different environmental commodity markets were centrally developed, many rules would need to be contested only once, design and implementation costs would be reduced, and government agencies would have the support of consistent advice identifying the processes they are required to follow, the gaps they need to fill, and the details to be refined by individual councils at local levels. Such a framework should include:

- Guidance on how markets interact with existing or new legislation (especially the RMA), and how to streamline the interaction between a market and the resource consent process
- A requirement that markets are underpinned by an environmental goal or cap (and complementary regulation), including examples or suggestions on how to establish a quantitative goal for various types of markets (the agency developing the market should determine the actual goal)
- Specification of measurement metrics and methods for different markets
- Guidance on appropriate liability rules for markets where not all participants are regulated
- Descriptions of allocation methodologies, and guidance on where and when the different methodologies could be used, and how they are put into operation
- An explanation of additionality requirements and where they are necessary

- Recommended monitoring protocols to assess attainment and maintenance of the environmental goal, and the actions of individual participants, for different markets
- Appropriate and legal trading processes, including trade notification, approval, and verification, and guidance on where each may be necessary
- Recommendations on infrastructure to support the market (both the marketplace and registry)
- Guidance on how to promote (and not restrict) innovation within the market rules (e.g. new opportunities to reduce pollution discharges)
- Guidance on conducting stakeholder engagement processes for markets
- Guidance on processes to review and update market rules
- Descriptions of available enforcement mechanisms, such as fines or penalties (that are much higher than the cost of not complying or the cost of the credit), collective penalties (where non-compliance by one participant means that all participants are penalised), short-term loss of individual cap, required remedial actions (e.g. including purchase of more credits than initially required), and restrictions on market participation, and capacity and infrastructure required for their implementation
- Issues that should be addressed by the agency developing the market, e.g. quantitative determination of the environmental goal, eligibility or participation rules, enforcement regimes, and guidance on these remaining local design decisions

Legislative amendments

Legislative changes or clarifications to New Zealand's environmental legislation may be needed to assist the routine establishment and implementation of environmental markets. We cannot offer a legal opinion, but offer some suggestions on the types of changes and clarifications that might be needed:

1. Enabling legislation

- Clarify in legislation the meaning of 'sustainable management' in the RMA. Currently, the environmental goal of a market may be subservient to a different statutory interpretation of sustainable management.
- Amend the RMA to require either the Minister for the Environment or territorial authorities and regional councils to specify measurable environmental goals, or promulgate new legislation that specifically deals with markets (either in general or by commodity) that would function alongside the relevant parts of the RMA. Currently, the RMA specifies that regional councils can establish resource allocation rules, but quantitative environmental goals needed for markets must be established by national environmental standards (Section 43), by individual councils or through new legislation. Therefore, regional and district plans that incorporate markets are likely to be open to legal challenge. An intermediate step could be to develop a policy document that outlines policy interventions (including markets) appropriate to various environmental issues and the corresponding relevant RMA section(s) that directly supports (or can support) additional legislation to implement such interventions.
- Amend the RMA both to enable councils to formulate precautionary rules and regulations (that are less open to challenge in the Environment Court) and to empower them more clearly to take precautionary action to address situations where an effect may not yet be clearly evident or effects are individually small but cumulatively large. Currently, councils and citizens bear the burden of proof of environmental harm, and must clearly demonstrate environmental decline (effects), and the cause and effects of decline (e.g. poor water quality) on a case-by-case basis. Potential environmental markets with appropriate precautionary caps will be open to court challenge, and may be expensive and difficult to defend especially if effects are subtle, slow to manifest themselves, are at an early stage, only become evident beyond some threshold, individually small, time-separated from their cause (e.g. groundwater lags and nitrogen pollution), or require a particular set of unusual environmental conditions to occur.

2. Effective enforcement

The ability to enforce market non-compliance should be strengthened by clearly allowing in the RMA for revocation of permits or allowances.

3. Market oversight

We suggest that a new avenue is required (independent of the Environment Court) for the public to bring grievances against a market administrator for lack of regulatory compliance in a market. This could be achieved by:

- Establishing an independent oversight committee or ombudsman to act as a grievance body for public oversight concerns with markets. Their role would be to protect public interests without compromise by market participants or administrators. They would need sufficient authority to address poor performance by market administrators (e.g. authority to overturn a poor decision and sanction dilatory regulators). Instead of court action, an ENGO, agency, business or citizen could raise a concern with the oversight committee.
- Requiring market administrators to submit annual reports to an oversight body, on attainment and/or maintenance of the overall environmental goal, number of trades, amount of the commodity traded, and location of trades. This body could rate the efficacy of various markets, and require poorly rated markets to undertake additional actions (e.g. revoke individual allocations for a period of time if a market participant fails to comply with trade conditions or obligations) and/or penalise market administrators.
- Developing legislation or binding policy requiring environmental markets to be subject to regular independent audits with specified terms of reference and tests for environmental compliance. Audits might include reviewing a sample of completed trades and activities implemented as part of the trade, and interviews with market administrators and participants.

Market infrastructure

Development of a standard national set of infrastructure (particularly a common marketplace and registry for all markets) could reduce the cost and capability needs of market administrators and facilitate engagement by potential participants in multiple markets.

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9. Definitions

Abatement
Actions taken to lessen the severity or intensity of environmentally harmful activities or discharges.

Auction
Sale of credits or allowances in which prospective purchasers bid against each other until the highest price is reached. In a reverse auction (sometimes used to increase the efficiency of a subsidy) (Greenhalgh et al. 2007b) prospective sellers bid against each other to accept the lowest price to provide a service.

Commodity
The good or service that is exchanged in an environmental market (e.g. nitrogen reduced, GHG emitted or sequestered).

Compliance environmental market
A market created and regulated by mandatory regional or national government regulation (and in some cases, binding international agreement and commitments such as the Kyoto Protocol).

Currency
Units of exchange used in an environmental market (e.g. tonnes of CO_2, hectares of habitat).

Environmental market
A compliance or voluntary market trading environmental commodities, where environmentally damaging activities are capped, and multiple exchanges of credits or allowances (including through auctions) are allowed between multiple sellers and multiple buyers.

Externality
A positive or negative effect on a third party not directly involved with the buyer or seller of the transaction.

Offsets
The term 'offset' is commonly used in GHG and carbon markets, and also increasingly in biodiversity markets, and has different meanings in different markets.

In a compliance carbon market, offsets refer to the reduction in GHG emissions (either credits from non-regulated sources or allowances from other regulated sources) purchased to meet regulatory caps. In voluntary carbon markets, offsets mitigate a source's own GHG emissions, and are generally in the form of credits purchased from non-regulated sources who have implemented an emissions-reducing project.

For biodiversity, ten Kate et al. (2004) have defined offsets as 'conservation actions intended to compensate for the residual unavoidable harm to biodiversity caused by development projects, so as to ensure no net loss of biodiversity' (p. 13). However, the term 'biodiversity offset' is increasingly used as a generic term for a variety of regulatory and voluntary biodiversity compensation programmes that are otherwise known as mitigation banking, biodiversity banking, biodiversity trading, conservation banking or species banking. Most such schemes neither fit the definition nor meet the standard of ten Kate et al. (2004).

Regardless of the context, offsets usually refer to an action that compensates (fully or in part) for the loss of environmental quality. For instance, where entities are unable to reduce their pollution discharge they may compensate for this by purchasing an 'offset' from other entities that can.

Regulated and non-regulated sources
These are facilities, plants, farms or other organisations that emit or discharge pollutants to the environment. They may or may not be regulated.

Regulation
Institutional measures aimed at directly influencing the environmental performance of polluters by regulating processes or products used, by abandoning or limiting the discharge of certain pollutants, and/or by restricting activities to certain times, areas, etc. (Opschoor et al. 1994, p. 15).

Standards
Technology standards specify the type of equipment or processes that each industry must adopt, while performance standards specify a target while giving sources flexibility in the methods employed to meet that target (Greenhalgh & Faeth 2001). Regulated sources of environmental harms must either comply with the prescribed levels of pollution abatement or environmental quality, or adopt the prescribed means of reducing environmental damage, or face a penalty (Opschoor et al. 1994).

Voluntary environmental market
A market created by an organisation(s) to meet an expressed desire to improve the environment. It is not underpinned by any mandated regulatory requirements. For example, there are many voluntary GHG markets that have arisen to capitalise on the growing global concern around climate change.

Appendix 1. Greenhouse gas markets

Legislation

Two Acts provide the legislative framework for the New Zealand Emissions Trading Scheme (NZETS): the *Climate Change Response (Emissions Trading) Amendment Act 2008* and the *Electricity (Renewable Preference) Amendment Act 2008*. They mandate a comprehensive emissions trading scheme, regulating the emissions/removals from all GHG sources/sinks, including forestry, stationary energy, industrial processes, transport fuels, agriculture, synthetic gases and waste. The scheme will be phased in, with all sources covered by 2015. All sources will be capped and will have to surrender sufficient allowances to cover their GHG emissions. Despite some recognised weaknesses,[37] the Act provides a clear legal framework for a mandatory GHG market in New Zealand.

There is no legislation relating to voluntary GHG markets in New Zealand. Once the NZETS is fully operational there will be few opportunities to participate in a voluntary market. A sector should be able to participate in a voluntary market until it enters the NZETS, but not afterwards.

Information and measurement methodologies

The NZETS implementation guidelines specify the measurement methodologies for the forest sector. A forester can use sequestration lookup tables (MAF 2009a) or take field measurements (MAF 2009b) to quantify carbon stocks. Field measurement is more accurate but more costly. Carbon stock estimates will differ between the two approaches, but some degree of consistency is promoted by the guidelines specifying how to apply these approaches.

The measurement details for the remaining sectors have yet to be determined. However, for stationary energy and transport fuels, emission estimates will be based on fossil fuels combusted. Methodologies for waste and industrial emissions are expected to be defined closer to the time they enter the NZETS.

The largest GHG measurement barrier is the uncertainty surrounding agricultural emissions. The challenges are twofold: one lies in measuring or estimating agricultural emissions, and the other in deciding who holds the obligation of surrendering emissions allowances in the NZETS. In general, the favoured points of obligation are 'upstream' sources, (e.g. electricity generators or fuel producers), which reduces the administrative burden by dealing only with a small number of participants. Upstream points of obligation for agriculture (i.e. meat processors, dairy manufacturers) are also preferred for simplicity and cost reasons.[38] However, this provides little incentive for farmers to reduce their emissions, but the cost and feasibility of monitoring a large number of farmers has to be weighed against the absence of incentives to reduce emissions (and hence the success of the market mechanism).

In voluntary GHG markets there are no mandatory methodologies used to estimate or quantify carbon stocks, and hence there is less certainty about measurement than in compliance markets. While standards exist (e.g. a voluntary carbon standard) that require verification of credits, measurement methodology guidance is not provided. Consequently, the lower credibility of voluntary credits compared with those generated within mandatory markets presents a market barrier. The real challenge here is to ensure and communicate the credibility of the credits.

[37] See Kerr (2007) for a review of the proposed NZETS.

[38] For a discussion on the points of obligation see Small & Kerr (2007). This was a project for the Ministry of Agriculture and Forestry that outlined a discussion of the points-of-obligation options for the agricultural sector, including the pros and cons of each option. This report is not publicly available. See also Kerr & Zheng (2009).

Interest group buy-in (political viability)

There are strong international political drivers for New Zealand to address its GHG emissions. However, whether certain business sectors or individual firms and products can maintain their competitiveness in an international commodity market is a key concern with the NZETS, and was partly the reason for the 2008 legislative review when the government changed. This concern relates to the regulation of emissions and the associated increase in costs, not the trading component of the NZETS (which was preferred to a carbon tax). Competitiveness is a valid concern for some products, but there are ways to address these issues, e.g. the free allocation of allowances to GHG-intensive, trade-exposed products (Greenhalgh et al. 2007b).

Programme governance and administration

Unlike most environmental commodities in New Zealand, GHGs are managed by central and not local government. This is appropriate because of New Zealand's international obligations to meet its negotiated Kyoto Protocol emissions target; any emissions above the national target must be offset by purchasing allowances offshore.

Central government created the Emissions Trading Group to oversee the implementation of the NZETS. However, administration of the *Climate Change Response Act 2002* is currently the responsibility of the Ministry for the Environment (see MfE 2008). The Ministry is also responsible for developing allocation plans and regulations under the Act, except for those relating to the forestry sector, which are managed by the Ministry of Agriculture and Forestry.

The Ministry of Economic Development (MED), however, will administer the NZETS, including the NZ Emissions Unit Register electronic registry. The registry will record:

- The emission allowance holders and the amount of emission allowances they hold
- Transfers of emission allowances between holders
- The surrender of emission allowances by participants in order to meet their obligations under the NZETS

MED also has audit and inspection powers to verify that participants have correctly complied with their obligations.

The NZETS will operate with a 'self-assessment' system similar to that used in the New Zealand tax system. Participants take the actions they are required to under the scheme, and the administering agency verifies their compliance either itself or through an agent. Participants face binding consequences for non-compliance with their obligations under the scheme. These include the giving of notices requiring compliance, penalties, and a requirement of participants to still surrender the units they owe (MfE 2008).

Many of the administrative barriers to operating a mandatory GHG market have been addressed, or will be addressed as the NZETS moves to full operation.

Market infrastructure

Infrastructure already exists for both voluntary and mandatory GHG markets. There will be no official marketplace for the NZETS; rather allowances will be listed on NZX and other similar exchanges. Thus, no real infrastructural barriers appear to exist.

Appendix 2. Water quality markets

Legislation

No specific legislation relates to establishing water quality markets in New Zealand, and the RMA is the most pertinent legislation. The RMA has no specific language pertaining to water quality markets and, as a result, a variety of sections of the Act need to be used to limit pollutant discharges, allow pollutant trades, and ensure compliance. This is not straightforward.

Regional council decisions are open to Environment Court challenges on the interpretation of the RMA in establishing a market's underpinning regulation and the market rules. This is not a trivial barrier, as the time and cost of establishing a market within the RMA may be substantial. It took seven years for Environment Waikato's Variation 5 to the Regional Plan (capping nitrogen discharges into Lake Taupo and establishing a nitrogen trading market) to come before the Environment Court, and a further six months before an interim Environment Court decision was made.[39]

Several sections in the RMA are relevant for establishing water quality markets. Agricultural nutrients are likely the biggest contaminant to waterways, and the primary concern for most water quality markets. To establish a water quality market, the RMA needs to allow regional councils the authority to control nutrient discharges, including those from agriculture. Section 15(1)(b) is probably the most relevant section for agricultural discharges and states that no person can discharge contaminants onto or into land that may enter water unless the discharge is allowed by a rule in a regional plan. This can provide the authority to control activities and assign discharge limits through resource consents, but requires a causal relationship between agricultural activities and discharges to water to be established. The actual trade of the permits or consents is covered under Section 137.

'Trading by rule' is also possible under Section 9 or Section 15(2)(a) of the RMA. Because these sections focus on land rather than discharges, the rules are critical, and so need to be quite prescriptive and will likely be challenging to formulate.

Despite the Environment Court ruling in favour of the Taupo Variation 5, any other proposed regulation capping nutrient discharges (with or without an associated market) is likely to face Environment Court challenges.

Information and measurement methodologies

Nutrient concentrations leaving a discharge pipe and water flow are easily measured; therefore, point-source discharges to water can be consistently and reliably quantified.

Measurement difficulties arise with non-point discharges. These discharges are diffuse and cannot be easily (or even feasibly) directly measured. Therefore, nutrient discharges are modelled based on management and biophysical (e.g. soils, climate) input data. The Overseer® model has been developed for New Zealand pastoral farming (horticulture was subsequently added), and was considered a suitable model to establish the initial discharge limits for pastoral activities in the interim Environment Court decision for the Taupo Variation 5.[40] It has not, however, been calibrated for all New Zealand soil types or management options. There are also other issues to consider. Most importantly, as Overseer® only includes reduction activities backed by robust science, there may be considerable time lags for new reduction activities to be incorporated into the model. This reduces innovation by farmers who identify new and different reduction opportunities. To recognise such innovation, additional market rules are required even if the contributions of such activities were to be heavily discounted.

[39] The final Environment Court decision had not been made as of May 2010.

[40] The interim Environment Court ruling can be found at http://www.ew.govt.nz/PageFiles/7058/Interim_Decision.PDF [accessed 6 April 2010].

Interest group buy-in (political viability)

A water quality market faces the same challenges as any other market. They generally involve the regulation of activities or pollutant discharges, and no person wants their current activities subjected to a new regulation. Even when sources are resigned to their activities being curtailed, how the environmental cap is allocated remains highly contentious.

In Lake Taupo, the farmers did not want their activities controlled. While farmers recognised actions were going to be taken to maintain lake quality, they preferred farming activities to be permitted activities and not become controlled activities (Mike Barton, Lake Taupo Care, pers. comm.). On the other hand, foresters were disgruntled with their discharge allocations, because these were based on existing forestry discharge rates. Their concern was the lost opportunity-cost of switching to a higher leaching land use in the future. Both parties took their respective grievances to the Environment Court. In Rotorua, similar issues have arisen with dairy farmers, because this sector contributes the largest source of nitrogen into the lakes. There is no easy answer to allocating discharge limits as there is no 'win-win' solution.

Nutrient markets are the most common water quality markets internationally, but markets also exist for water temperature and selenium (salinity) levels, and have been trialled for mercury. Debate ensued in the US over the use of markets for other toxic discharges (such as arsenic), and trialled mercury markets came under severe criticism from environmental groups because of the implications of localised high levels of mercury in waterways (i.e. hotspots). While other pollutants may cause some localised adverse effects, they are generally less environmentally damaging and cause fewer health impacts than toxic substances.

Programme governance and administration

Regional councils will likely administer water quality markets and will need the skills, finances and physical resources to design, implement and operate them. However, many councils lack these resources.

To establish markets, operating rules need to be designed, discharge limits promulgated, internal operating processes (e.g. consent change approvals, who handles changes in discharge notifications, etc.) set up, the consent process aligned with the trading process (in the case of a 'consent-based' market), and monitoring programmes and enforcement mechanisms implemented. None of these tasks is trivial. A successful market will also require carefully designed and powerful governance to strengthen accountability and achieve environmental goals. For these reasons, inadequate council financial and human resources will present a major barrier to water quality markets.

Further administrative difficulties will arise where regional council jurisdictions share water catchments (e.g. the Waitaki catchment, Canterbury).

Market infrastructure

While no marketplace or registry infrastructure currently exists in New Zealand for water quality markets, marketplaces or registries exist overseas and for different commodities in New Zealand (e.g. GHGs, water quantity). These could be adapted for New Zealand. Water quality markets that operate within a consents framework may have initial challenges with developing a registry that sits beside the relevant consent database and process.

Facilitating water quality markets in New Zealand

Consistent new legislation or binding policy could ensure that the higher-level principles of water quality markets are contested only once. Among its principles should be the prohibition of the trading of toxic substances (such as those defined in the *Hazardous Substances and New Organisms Act*) in waterways, and stipulation that trades can only occur between two sources in the same catchment (because the impact of discharges to water is only apparent within the relevant catchment or in the coastal area or lake into which the catchment drains), and that environmental caps and allocations must then be unique to each catchment.

Appendix 3. Water quantity markets

Legislation

Under the RMA, permits to take water or discharge can be transferred to other sites if allowed in the plan and approved by the council. But, as with water quality markets, regional council decisions will be open to court challenges, most likely on the market's underpinning regulation and the rules for market operation.

Currently, no formal water quantity market operates in New Zealand, but a marketplace does exist.[41] It uses Section 136 of the RMA as its legislative base. This section specifies that water permits (a type of resource consent) may be transferred in whole or part to another person or another site provided the site is within the same catchment, aquifer or geothermal field, and provided that transfer of water within the area is allowed under the relevant regional plan. Catchments, aquifers and geothermal fields are defined by the regional plan.

The existence of a marketplace alone does not do away with legislative barriers. Successful water quantity markets generally require water to be set aside to meet public[42] needs (Sax 2008). Under the RMA, water take permits may lack sufficient specification to enable this (e.g. daily volume is not specified in permit conditions in Canterbury; Gunningham 2008). Without adequate water-accounting regimes, councils cannot estimate how much water is being consumed in aggregate, and whether this exceeds environmental limits; hence they find it difficult to defend court challenges to allocations and restrictions on take. If initial permit allocations are not limited to actual use, trading will increase (rather than decrease) water use, because participants can sell previously unused water allocations and have less incentive to innovate to reduce use. Moreover, environmental goals may be compromised if new consents are issued above initial market allocations. To address these deficiencies, additional legislation may be needed to stipulate appropriate permit conditions, clarify water-take monitoring standards and reporting requirements, and specify temporary permit variation rules that respond to lower than average water flows.

Measurement of water take varies considerably between regions in New Zealand. Currently, the RMA does not require metering of water takes. However, the National Environmental Standard for Measuring Water Takes imposes mandatory flow reporting requirements on water permit holders to a specified accuracy from 1 July 2010.[43] This may remove an important barrier to water quantity markets, as (in theory) all water takes should be measured and monitored to a minimum standard.

Information and measurement methodologies

Most water takes in New Zealand are not metered, so there is little information on the water extracted from surface and groundwater resources. Water take and the timing of the take have to be metered in order to effectively allocate, monitor and enforce water permits in a market. The water level below which water take is disallowed must also be clearly specified and communicated (e.g. in-stream visible flow gauges that mark minimum water flows or the flows which trigger restrictions).

Information constraints to water quantity markets extend beyond metering. While water-take meters can measure (with adequate certainty) the amount of water being taken from surface waters or underground aquifers, there is greater uncertainty about the amount of available water each year. Annual precipitation cannot be predicted and inter-annual recharge of aquifers and relationships between surface and groundwater cannot be easily or feasibly measured directly; rather this must be modelled based on the biophysical environment and other input parameters. This 'availability uncertainty' requires the programme rules or legislation to stipulate that annual, seasonal, monthly or daily water take is flexible and must match availability. Therefore, actual water availability must also be monitored.

[41] https://www.hydrotrader.co.nz/ [accessed 6 April 2010].

[42] For example, 'to meet fishery and ecosystem sustenance needs, for public recreation, for navigation, and to fulfil customary rights to which indigenous people have an entitlement' (Sax 2008, p. 6).

[43] See http://www.beehive.govt.nz/release/new+regulations+improve+water+management [accessed 1 June 2010].

Market participation

Where trading must be spatially restricted to maintain environmental flows within catchments, there may be too few traders and exchanges to support a viable market.

Interest group buy-in (political viability)

There are many uses of water – ecological, agricultural (livestock and irrigation), residential (rural and urban), industrial, recreation and 'mauri'.[44] Typically, water quantity markets operate for agricultural (and occasionally industrial) uses, and ecological, residential, recreational and 'mauri' uses are considered non-discretionary uses of water. The challenge with any water quantity market is to determine the amount of water assigned to each of the uses and then the amount that can be traded. Environmental flows can be defined based on natural mean annual low-flow levels in a waterway, specified high flows required to 'refresh' waterways, levels that maintain specified temperature controls, and recreational needs (e.g. must be certain flow levels on weekends), while residential uses are estimated using per person or per household daily water consumption. Agricultural and industrial uses then have access to any remaining water. The challenge is to predict the actual water flows at any given time, and allocate flows so all non-discretionary uses are protected.

Water quantity markets are contentious. As with other markets, potential traders resist rules that reduce existing actual or tacit use rights. Other stakeholders (mainly passive users) are concerned about the ethical and equity issues raised by the ownership and trading of water, which is perceived as a common resource. The question of customary rights is prominent.

Water users may be wary of markets where they perceive a council might withdraw water-take permits under a use-it-or-lose-it provision if they transfer water permits (e.g. Tasman District; Harris Consulting 2003, p. 24). In this district, it was also reported that 'for a number of extractors the concerns about transferability echoed those of other stakeholders, and reflect a common view of water as a public or common property for the community' (Harris Consulting 2003, p. 19). Here the view is that the 'proper' use for water is as a public and free resource, and buying and selling the water is not considered appropriate. Opinion was divided among other stakeholders regarding the desirability of transfer. Some had no concerns and felt a market would allow water to go to the highest value or most efficient use, while others had a philosophical objection to trading what is seen as common property. Others did not object directly to transfer, but objected to consent holders profiting from a free resource and would only favour transferability if consent holders paid for the resource. Some individuals voiced concerns that a market system could give rise to 'water barons'.

In another case study of water management issues in the Motueka catchment (Sinner et al. 2006), stakeholders (including iwi, local and central government, irrigators, communities and environmentalists) were asked to comment on various water quantity control measures. In response to downstream transferability of water permits, and whether this should or should not be allowed, irrigators and community development groups were in favour while environmental interests, all levels of government, and iwi were neutral to the idea. Further, there was overall agreement from all groups that water metering should become mandatory. These responses are indicative only, and are not the united opinion of each group. However, there appeared to be no strong opposition to what may be considered two contentious aspects of water quantity markets – monitoring and transferability. Political reactions to water quantity markets in New Zealand are diverse, and the above examples may not reflect stakeholder views in other regions and districts.

[44] 'Mauri' refers to the intrinsic value of the waterway and represents the Māori perspective on waterways.

Programme governance and administration

Experience in Australian water quantity markets suggests these markets may become very complex to administer and govern (Bell & Quiggin 2008). As with water quality markets, water quantity markets are likely to be administered by regional councils with similar resource requirements and constraints.

Market infrastructure

There are no real market infrastructure constraints as a water quantity marketplace, and supporting registry, does exist in New Zealand. In addition, an example of monitoring infrastructure also exists.[45] The main barriers associated with water quantity registries therefore appear not to be technical, but seem rather to be associated with establishing markets rules and the authenticity of permits as a basis for trading.

Facilitating water quantity markets for New Zealand

Water needs to be allocated at the catchment level, and each catchment is unique. But, as with water quality markets, consistent new legislation or binding policy could ensure that higher level market principles are contested only once. These principles should include that:

- Any allocation of water must take into account environmental, residential, recreational and 'mauri' uses before allocating water to agricultural and industrial users
- Allocation is tied to available water supply, therefore, allocations are a proportion of the available water (after non-discretionary uses have been satisfied), and likely to change over time (and seasonally if necessary)
- All water takes are measured (amount and timing of take) where a market operates

Additional research is also required in most catchments to clarify surface–groundwater interactions to ensure water allocation considers surface and groundwater flows.

[45] Horizons Regional Council (Manawatu-Wanganui Region) has developed the Watermatters registry, a voluntary web-based information system for water consent/permit holders who have an interest in monitoring their water use. The register currently covers 70% of water consent holders for the region (Horizons Regional Council 2008). While not a market registry, it provides daily water use amounts for individual management zones or for whole catchments. System users are afforded full transparency of what their neighbours are doing and the system will facilitate any future water quantity market. Full automation has contributed to high participation rates in the registry. See http://www.horizons.govt.nz/watermatters [accessed 6 April 2010].

Appendix 4. Biodiversity markets

Legislation

New Zealand law currently contains no prohibitive rules or caps that could effectively drive a biodiversity[46] market (as in the *US Endangered Species Act*). Rather, a non-statutory national biodiversity strategy exists (the New Zealand Biodiversity Strategy or NZBS; DOC & MfE 2000), that also represents New Zealand's obligation under the international Convention on Biological Diversity. Goal Three of the NZBS is to 'Halt the decline of New Zealand's indigenous biodiversity' through protecting a full range of habitats and maintaining viable populations of all indigenous species.

The RMA is the major statute for decision-makers determining whether indigenous habitats and ecosystems on private land may be cleared or protected against harm. Unlike discharges and water take (where no person may discharge or take unless specifically allowed), the presumption for biodiversity is that it may be removed or destroyed except in specific circumstances. Local government agencies with statutory functions under the Act are required by Section 6(c), as a matter 'of national importance', to recognise and provide for the protection of 'areas of significant indigenous vegetation and significant habitats of indigenous fauna.' Assessment of 'significance' is central to this determination, but is not defined by the RMA.

The NZBS observes (p. 37): '[RMA] provisions to promote the protection of significant indigenous vegetation and habitats have not been effectively implemented across New Zealand' and notes 'difficulties in defining the meaning of "significant".' Definitions vary greatly among districts. In RMA processes, developers may destroy or modify sites deemed not to contain significant values, or when negative impacts on significant sites are considered to be adequately mitigated. Importantly, avoidance, remedy and mitigation can be interpreted as equally preferable alternatives in the RMA and not as a hierarchy (as is common elsewhere). Therefore, there is no requirement to consider the least damaging avoidance option first.

Initiating a market for biodiversity in New Zealand would likely require new legislation to prohibit removal of biodiversity unless specifically allowed in circumstances set out in detailed market rules. However, there is still potential under the RMA for legal challenge where a party perceives that less demanding (and more environmentally damaging) mitigation practices satisfy RMA requirements (so trading by market rules is not necessary).

Ad hoc developer-provided biodiversity mitigation projects (often referred to as 'offsets') are creating precedents for biodiversity exchanges in RMA case law. For example, there is a trend to accommodate replacement of all or part of significant sites with developer-provided mitigation within the interpretation of 'protection' under Section 6(c) (Christensen 2008; Norton 2009). This trend will compromise any eventual development of successful biodiversity markets, because exchanges are occurring before public consultation and development of the rules, governance and administrative structures, currency, and resources needed to support a credible environmental market.

Trading markets for biodiversity also face legal barriers from New Zealand's trespass and privacy laws, which restrict the collection and use of biodiversity information from private land (some 70% of New Zealand land area), needed to supply the information for a biodiversity currency.

[46] Here we refer only to indigenous biodiversity, and not introduced species.

Information and measurement methodologies

Measurement and estimation challenges in biodiversity markets are particularly severe. Unlike some simpler commodities, which have currencies that can link directly to a market's environmental goal, biodiversity currencies are not capable of capturing 'what we care about' (Salzman & Ruhl 2000, p. 694).

No satisfactory conceptual basis exists for measuring biodiversity that is both theoretically sound and suitable as a currency for trading biodiversity losses (to development) and gains (from conservation or mitigation). Biodiversity is complex, hierarchical in its organisation (from genes through to ecosystems and landscapes), extraordinarily varied at each level, intricately interrelated within and between levels, and has components that are non-interchangeable. Non-interchangeability is important because maintaining diversity is central to biodiversity policy goals, nationally and internationally. There is no simple currency that can measure equivalence among sets of biodiversity. A satisfactory measure of biodiversity would include both pattern[47] and process[48] information. Methodologies to construct pattern measures have been developed, but the data to apply them widely are deficient. Neither the concepts and theory nor the data to appropriately incorporate processes into an exchange currency have been developed.

A market requires simple measures, which is why unsatisfactory measures and metrics (e.g. area of some habitat type) have been adopted for biodiversity markets (Salzman & Ruhl 2000). These metrics do not reveal what biodiversity components (pattern) and processes are actually being exchanged. This results in poor transparency about, and accountability for, what is being exchanged, which facilitates damage to biodiversity.

Even seemingly more sophisticated metrics such as the habitat-hectares native vegetation scoring method[49] are only weakly related – if at all – to the level of biodiversity.[50] The upshot is that an increase in habitat hectares may not signify a real or concomitant increase in the extent or the quality of native vegetation, or an improvement in biodiversity.[51] And when used in biodiversity compensation markets (e.g. Victoria's BushBroker Scheme in Australia), the habitat-hectares metric will obscure any biodiversity loss that results from exchanges.

In US Wetland Banking there have been several attempts to develop more meaningful and adequate (and hence more complex) currencies that better reflect wetland functions or habitat values. However, acres of habitat for a particular species remain the major currency. 'In practice, the currency choice has been based on the path of least resistance. A comprehensive currency is too expensive to mint and too arduous to use' (Salzman & Ruhl 2000, p. 661).

The proposed Western Cape Biodiversity Offsets Program in South Africa draws on significant survey and research[52] information to classify and map habitat.[53] This partly addresses inherent biodiversity

[47] The components of biodiversity that occur at range of hierarchical scales.

[48] Ecological processes maintain pattern diversity and include such things as migration, dispersal, pollination, source–sink dynamics, natural selection, population dynamics, predator–prey dynamics, seral development, breeding patterns, competition, nutrient cycling, and decomposition.

[49] Developed for biodiversity markets in Victoria, Australia. (See Parkes et al. 2003, 2004; McCarthy et al. 2004.)

[50] Briefly, the habitat-hectares metric takes little account of biodiversity features (e.g. rare species, valued spatial functions) unless they are specifically chosen as key habitat condition attributes. Further, it makes the questionable assumptions that (1) 'quality' (scored with arbitrarily selected habitat condition attributes and weighting) is exchangeable for area and (2) different condition attributes are exchangeable. For habitat hectares to be a meaningful exchange currency for biodiversity, there would need to be a linear relationship between the habitat hectares' 'condition' score and some measure of absolute biodiversity (such as species occupancy), and biodiversity components would need to be lost at random as condition deteriorated, or gained at random as condition improved. Ecological studies suggest both are highly unlikely.

[51] Commenting on this metric as applied in the State of Victoria's BushTender auction scheme, Salzman (2005) notes 'such calculations are only meaningful, however, if the scoring systems (which are estimates of service provision) prove credible. If the assessment of biodiversity value proves to be poor, then there is no assurance that the money was well spent nor that the public is actually getting value for money' (p. 905).

[52] The programme has access to exceptionally detailed high quality, high resolution biodiversity habitat maps and conservation plans, funded independently by post-apartheid conservation donors such as the World Bank. Similar resources are not available in most nations, including New Zealand.

[53] The Western Cape's habitat classifications are critically endangered, endangered, vulnerable and least threatened. These categories have been defined in the *NEM Biodiversity Act* 2004.

measurement difficulties and increases the probability that offsets will be genuinely 'like-for-like'. Moreover, the programme proposes offset ratios that are linked to ecosystem status, which should cap future loss at a proportion of what now remains. For instance, if some critically endangered habitat is to be developed, then a 30:1 offset would be required, entailing permanent protection of an area of the same critically endangered habitat 30 times larger (Brownlie et al. 2007).

Biodiversity assessment depends on contextual information at several spatial scales. For example, understanding the threat status of a component requires knowledge not only that it exists in a place, but also where else it exists in a region or country, and the marginal benefit of pest control for biodiversity depends on that carried out previously, later, and elsewhere. Even if a measure or currency did satisfactorily describe biodiversity, it would be challenging to implement because the systematic contextual information needed to support it would be deficient. In New Zealand, biodiversity pattern information (inventory) is limited, and largely confined to public conservation land. Much of it pre-dates the 1980s.[54] Biodiversity information on private land (where trading is most likely to occur) is particularly scant, and legal access constraints prevent systematic survey to provide the necessary data coverage. Understanding of biodiversity processes in New Zealand is also rudimentary and very local (i.e. applies at plot to patch scales only).

While it is possible to construct some pattern-based measures for New Zealand using existing biodiversity information, their level of resolution is very low, especially on private land where there are fewest data. Process information would be outside the measure. Such measures could not describe the biodiversity involved in an exchange.

Lastly, while establishing additionality is difficult in all markets, it may be especially challenging for a biodiversity market.

Market participation

Even if measurement issues and legislative constraints to biodiversity markets could be overcome, in practice ecological constraints mean there may be limited scope for such markets while meeting New Zealand Biodiversity Strategy goals (or targets of 'net gain' or 'no net loss' as proposed by ten Kate et al. 2004; Christensen 2008; Norton 2009). Experience shows few New Zealand ecosystems can be realistically reconstructed de novo, much less within realistic time frames for industry.[55] Markets based on restoration are unlikely to succeed except in a narrow range of situations,[56] so an interim drawdown[57] model of exchange may not be plausible, and restored mitigation banks difficult to establish, and find a limited number of buyers. There is potential in New Zealand to rehabilitate and enhance a subset of ecosystem components in some existing ecosystems (e.g. increasing bird populations through activities such as pest control).[58] Such enhancement replaces only minor modifications of habitat (e.g. pest impacts) rather than complete habitat clearance, so demand for this activity is likely to be restricted in a market. There is no conceptual basis for trading clearance for enhancement activities.[59] Furthermore, New Zealand's small size, and restricted opportunities for

[54] An inventory of New Zealand's existing biodiversity information was conducted in the mid-2000s (Cieraad 200, unpubl. report to the Department of Conservation).

[55] For example, even simplified wetlands will take at least a century before woody components become maturely established, and the presence of many native birds and insects will depend on vegetation composition, structure and context in the landscape. This problem would be worse in New Zealand than overseas where Recent (Holocene) ecological history creates more potential for the full restoration of present-day habitats.

[56] Replacement is possible for only a very few, young, simple, ecosystem types comprising high mobility, common, generalist species, such as saltmarshes, coastal dunes, and young kanuka or matagouri shrublands. It is not possible to recreate most of New Zealand's primary and early post-settlement ecosystems (e.g. forest, limestone pavement, tussock grassland, and most wetland types).

[57] Walker (2008) and Walker et al. (2009) define three models of trading: (1) *permanent drawdown,* allowing destruction of existing ecosystems or species habitats in exchange for improved protection of other, already existing ecosystems or habitats; (2) *interim drawdown*, allowing ecosystem or species habitat destruction before reconstruction, generating immediate ecosystem or habitat loss and interruption of ecological processes, and risk permanent loss through restoration failure; and (3) (true) *banking*, requiring biodiversity replacement before development occurs.

[58] Specifically, some palatable plants (herbivore removal, reintroductions), some competition-sensitive plants (weed control, reintroductions), and some predator-sensitive animals (reintroductions, pest control) (Walker 2008).

[59] For example, how many hectares of possum control – and over what time frame – would be required in exchange for permanent clearance of a hectare of forest? Ecological science presently has no logical framework to answer this question.

protection in developed environments, may mean supply and demand is too limited for a permanent drawdown[60] trading model along the lines of US conservation banking.

Interest group buy-in (political viability)

ENGOs regard biodiversity markets with suspicion. This is because overseas examples are not encouraging and some examples of ad hoc 'offsets' in RMA case law resemble the earliest and now discredited models tried overseas (i.e. interim-drawdown and developer-provided mitigation; see for example Gardner 2000, pp. 1–2). ENGOs see these examples as undermining already limited protection for biodiversity on private land. Development companies, however, are more supportive as markets offer flexibility and greater access to resources. On the other hand, a strong legislative market driver (such as a cap on native habitat clearance) and precautionary rules and exchange restrictions would likely be opposed by economic development interests.

Additionality is a key motivating factor for private individuals involved in voluntary restoration efforts (e.g. sanctuaries). Many of these volunteers are unwilling to trade their restoration efforts for money given in return for biodiversity loss elsewhere. This may limit the supply of enhancement credits. Therefore, the creation of enhancement banks by the commercial sector may be poorly received. Similarly, developer-funded enhancement projects on public conservation land may be resisted on the grounds that they could provide a rationale for government to reduce public conservation funding, so may not be truly additional.

Programme governance and administration

Biodiversity markets place very high demands on oversight and administrative expertise and resources. Experience from the USA and Australia is not encouraging; federal and state governments have been reluctant to invest enough resources in the administering and oversight agencies, resulting in very poor implementation, monitoring and enforcement. Most New Zealand councils, and in particular district councils, will be inadequately resourced and insufficiently equipped for the task. [61]

Market infrastructure

The barriers to biodiversity market infrastructure are not technical. Marketplaces and registries exist internationally for biodiversity markets, but issues around biodiversity information and robust measurement methodologies affect the credibility of markets.

Facilitating biodiversity markets in New Zealand

Biodiversity is the least amenable of all environmental commodities to management via environmental markets. International experience is generally discouraging. A central problem is that biodiversity is too complex to be quantified in an adequate, simple currency, and consequently very difficult and expensive to measure. Exchanges need extensive restrictions to avoid environmental harm, and effective enforcement is demanding, and may be impractical. Even if these and other factors constraining the supply of biodiversity goods and the number of traders in markets could be overcome (which may not be possible), establishing a credible biodiversity market in New Zealand would require major changes in legal, administrative and biodiversity information arrangements.

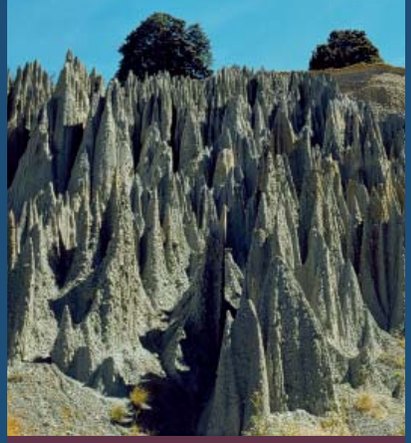
Legal steps needed to successfully establish biodiversity markets would likely include (a) legislative review and new or amended legislation to conserve native flora and fauna that sets prohibitive rules or caps to effectively drive a market, and establishes a clear environmental goal, that (b) stipulates exchange restrictions at a national level, including listing community types, habitats and ecosystems that could not be developed and offset, and (c) that limits exchanges to full community or habitat type, including (but not limited to) species or taxa of special concern.

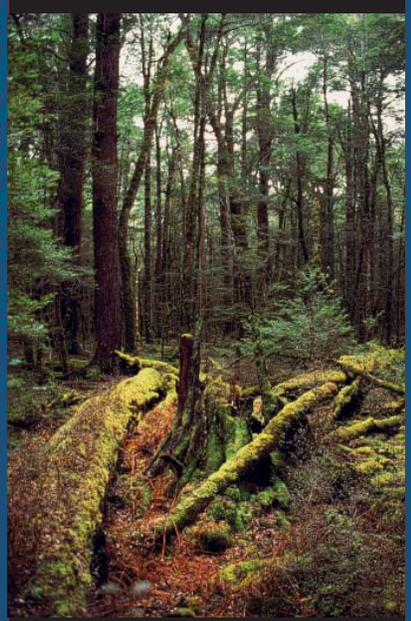
[60] Defined in footnote 57 above.

[61] See, for example MfE's 2004 'Snapshot of council effort to address indigenous biodiversity on private land: a report back to councils' http://www.mfe.govt.nz/publications/biodiversity/indigenous-biodiversity-private-land-jun04/index.html [accessed 6 April 2010].

In the RMA, the definition of protection (Section 6c) would need clarification to exclude modification and partial or interim destruction, and to introduce requirements for (a) a hierarchical avoid–remedy–mitigate process (that first avoids adverse effects, then remedies or minimises the adverse effects, and finally mitigates only any residual unavoidable harm) and (b) demonstrating that the mitigation hierarchy has been appropriately implemented.

There is currently no international consensus of what an appropriate biodiversity measurement metric should be; any robust biodiversity metric will likely be integrative and highly complex, and challenging and expensive to implement. There is insufficient biodiversity information available in New Zealand at present to populate such a metric. Should a robust measurement metric be identified, national legislation would be needed to specify its use, along with relevant methodology and standards, and to establish – with secure funding – an appropriate systematic biodiversity inventory programme to collect the requisite biodiversity information on Crown and private land.





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