Going with the grain

Changing land uses to fit a changing landscape

May 2024

Parliamentary Commissioner for the Environment
Te Kaitiaki Taiao a Te Whare Pāremata

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Contents

A personal reflection

This is a report about land use change – what drives it and what stands in its way. It is not a matter of academic interest. My family arrived in the Raglan hill country in the 1850s. Ignorant of the land into which they stumbled, my forebears turned their backs on the Waikato floodplain and went into the hills. They appeared to be more productive – after all, they could support dense forest. And where the soil under the trees they cleared was well-drained ash, amidst limestone outcrops, it was good stock country. But where there was only a fragile veneer of soil over hard clay, it was a struggle.

In the 1940s, my great uncle left the hill country and purchased a smaller block on the western side of the central Waikato plain. It too had seen continuous land use change. Before European settlement, the well-drained sandy loams were good sites for kūmara. The deeply incised gullies cut through the volcanic outwash were wetlands filled with eels. The first European farming was surprisingly varied. There was dairying early on and there was also wheat being grown.

But the farm I grew up on was a sheep farm. My father bought it from his uncle shortly after the Korean wool boom. It was downhill all the way after that. When I was ten it became a beef unit. We didn't convert to dairying as many did. But no matter, it has effectively become a dairy support unit with some beef on the side and a small market garden.

The changes to my farm over the last 80 years have mapped the changing economics of livestock farming. And over the last decade they have started to chart the rising tide of concern about the state of our environment. About ten per cent of the property has been taken out of production to recreate the wetlands that filter down to the Waipā River.

How I came to live on the land that I call my home is a very ordinary tale of no special interest. I recount it to be upfront about the fact that I am not a disinterested party and not indifferent to the pressures that are bearing down on farming. But I am equally aware that landowners cannot disown the environmental harm they cause just as they can't ignore the costs that a changing climate will impose whether we like it or not. Environmental clean-up is not optional.

When markets move, land uses change. That has been the history of the last 170 years. Profitable new activities – or new ways of doing old things – can support land use change. If they entail a lower environmental footprint, we all win. Even then, the social costs may be controversial. Carbon farming is a case in point. Businesses wanting to earn carbon credits offer an exit strategy for a landowner wanting out, but pose a headache for the local school or livestock carrier.

But where the case for environmental clean-up comes without a market-driven solution, regulation is needed to provide the incentive to do better. But that raises an even more intractable problem: where's the money going to come from? At any one time, some land uses will be on the winning side while others are up against the wall. Right now, we have a profitable dairy sector with a large endowment of skills and technologies both on and off-farm, with some very large, corporate-scale operators. For the sheep and beef sector, the boot is on the other foot. Its profitability is marginal so its ability to invest in change is much more fragile.

The political economy of steering land use change in a consistently sustainable direction is not for the faint-hearted. The easy way forward will always be to spend public money. But the scale of the problem far outstrips the public purse. And in any case, if food and fibre are to continue to be internationally competitive industries, they can't rely on subsidies whether they are financial or environmental.

Plans to reduce the environmental impact of farming can't ignore the question of who pays. Neither can they be imposed uniformly from a distance. While some national direction and support is needed, different land uses in different catchments pose different risks. We need to couple the detailed local expertise and knowledge of farmers, mana whenua and communities with fine-grained land information to channel investments to the parts of the landscape that will deliver the biggest environmental gains. In short, we need solutions that run *with* the grain of the land.

Coming from rural New Zealand, I find it easy – perhaps too easy – to sympathise with farmers confronting what seem to be ever mounting environmental challenges. But farmers don't need sympathy. They need really good environmental information, excellent market intelligence and access to finance. And they need regulations that will make environmental indicators trend in the right direction in the least costly way possible. This report offers some ideas on how that might be achieved.

Simon Upton

Parliamentary Commissioner for the Environment
Te Kaitiaki Taiao a Te Whare Pāremata

1

Rumohra adiantiformis

How this report came to be written

We need to change the way we use the land if we are to hold the line on environmental quality, let alone improve it.

But it has to be said that land use is, in any case, in a constant state of change. What future landscapes of Aotearoa will look like, and the state of their environmental health, will depend on at least two things. A changing climate will force changes to what we do where on the land – and how we do it. And then there will be the changes that flow from the decisions that people make. These are driven by everything from local environmental and planning regulations to who we trade with and evolving consumer preferences abroad.[1]

Some of these changes will be incremental and take decades. Others will be more abrupt and involve switches to new land uses. All of them will affect our attempts to deal with freshwater, biodiversity and our contribution to mitigating climate change.

Changing land use to achieve environmental objectives involves a spectrum. At one end of the spectrum there is change to management practices within the same farm system, where the effects of existing land uses are mitigated through specific interventions. This could range from planting trees in low-productivity areas and restoring wetlands, to changing the mix of crops or grazing animals, or intensifying the use of other land parcels. At the other end of the spectrum, there is wholesale land use change from one specific use to another.

How much environmental degradation can be mitigated through changes of practice and how much requires wholesale land use change will depend on each farm. One thing is clear: our landscapes today look very different to how they looked a century ago, and by the end of this century they will look very different again.

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[1] Since 2004, our trade with China has grown more than eightfold from ca. $4.7 billion to ca. $39.5 billion (Stats NZ, 2024a, b). Meanwhile, consumer preferences in other markets may be having more impact on how we use land than attempts to regulate it. Nestlé and Tesco UK both have stringent net zero 2050 targets that include their scope 3 emissions from farming, and they are piloting Science-Based Targets initiatives, which aim to improve biodiversity (Nestlé, 2023; Tesco UK, 2023). Both are big buyers of New Zealand dairy and meat and so this has direct impacts on New Zealand producers and the way they farm (Rennie, 2023; Uys, 2023). It has led Fonterra to announce stricter climate targets as well, although these remain based on 'intensity' rather than absolute reductions (Wannan, 2023). The power of consumers and markets is further compounded not only by the increasing prevalence of climate-related disclosure regimes (now mandatory in New Zealand, see MBIE, 2023) but also by the introduction of the much broader nature-related disclosure regimes (see, for example, TNFD, 2023).

My predecessor Dr Morgan Williams, in his 2004 report *Growing for good: Intensive farming, sustainability and New Zealand's environment*,[2] started a national conversation about the effects of intensive farming on the environment. He also laid out a possible way forward, which included a call for 'integrated catchment management'. Dr Jan Wright continued this line of inquiry with her 2013 report *Water quality in New Zealand: Land use and nutrient pollution* and its 2015 update.[3] This present report continues these conversations.

In the 20 years since Dr Williams' report, we have seen continuing intensification of some land uses, wholesale changes in others, and a raft of attempts (with variable success) to use environmental regulation to manage the consequences. Concerns about the effects of livestock farming, particularly dairying, on water quality has led to five iterations of a National Policy Statement for Freshwater Management.[4] There have also been stop–start attempts to preserve biodiversity on privately owned land.

Running a farm has become a much more complex business, with significant recent changes in banking, processing, and environmental regulation. A widely repeated view among farmers is that there is too much disjointed regulation of on-farm activities that does not consider their cumulative impacts. In the winter of 2023, Beef + Lamb New Zealand's chief executive Sam McIvor had this to say:

> "The Government needs to pause, review, reassess and simplify its approach to policies. Policies are all too often fragmented and impractical. A more holistic view is needed to develop sensible and pragmatic regulations that enable farmers' ongoing stewardship of the land."[5]

Ironically, it is not on-farm regulation that is currently forcing the most substantial changes in the way we use land, but attempts, far from the farm gate, to mitigate our fossil fuel emissions. For as long as New Zealand has been debating doing something about climate change, storing our carbon dioxide emissions in trees on the landscape has been our preferred get-out-of-jail (almost) free card. However, I have had growing concerns about the sustainability of this approach to climate mitigation.[6]

In my *Farms, forests and fossil fuels* report, released in March 2019, I explored what the implications of the Government's climate change targets and policies might be for New Zealand's landscapes.[7] I commissioned modelling of the scale of land use change that would be expected to occur at the national level if all emissions were priced the same, including those from agriculture,[8] and all emitters were allowed unlimited access to forestry offsets through the New Zealand Emissions Trading Scheme (NZ ETS). The short answer was that a lot of land would be converted to forestry – up to 5.4 million hectares (or 54%) of current farmland by 2075,[9] most of it in Canterbury, Otago and Manawatū-Whanganui.

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2 PCE, 2004.

3 PCE, 2013, 2015.

4 NPS-FM 2011; NPS-FM 2014; NPS-FM 2014 as amended in 2017; NPS-FM 2020; and the NPS-FM 2020 as amended in 2024. The new government has also signalled that it will start work to replace the current NPS-FM 2020.

5 B+LNZ, 2023.

6 PCE, 2023a.

7 PCE, 2019a.

8 Emissions from the agricultural industries are currently not being priced. The current coalition government has signalled it will introduce agricultural emissions pricing by 2030.

9 Based on roughly 10 million hectares of agricultural and horticultural land use (excluding forestry) in 2019 (Stats NZ, 2021a).

The modelling for that report also tested an alternative approach in which a separate target was set for gross carbon dioxide emissions from the transport, energy and industrial sectors, while access to forestry offsets was reserved exclusively for biological emitters. Under this alternative approach, a 'mere' 3.9 million hectares of farmland would be converted to forestry by 2075.

To get a better understanding of the problem, I commissioned some follow-up work to calculate the area of forest that would be required to achieve roughly the same change in temperature as reducing a herd of livestock by one animal. The answer – 0.6 hectares for a single dairy cow – confirmed that while forests could theoretically be used to offset warming from livestock methane emissions, very large tracts of forest would still be needed to make any significant dent in the warming effect of New Zealand's livestock methane emissions.

Farms, forests and fossil fuels also attempted to downscale the national-level modelling to a specific catchment to see what offsetting emissions with trees could mean for a particular community. I chose the Hurunui in Canterbury. But the modelling was relatively crude and suffered from several limitations: the resolution was coarse, land uses were represented using national averages rather than being catchment-specific, and the only environmental indicator assessed was greenhouse gas emissions.

Furthermore, the report's scope was restricted to modelling the impact of emissions pricing on land uses. The impacts of other environmental policies, such as freshwater quality regulations, were not considered. Neither was any input sought from mana whenua or the local community.

I concluded the report by calling for a landscape-based approach to managing climate and other environmental challenges. The idea was to integrate "all that we know about environmental processes at the landscape scale with bottom-up, grass roots knowledge".[10] Rather than wait for the recommendation to be politely shelved, I decided to test the idea by using more fine-grained, catchment-specific modelling tools and engaging with the mana whenua and communities directly concerned.

It just so happened that during my review of the Overseer model in 2018,[11] I came across the work of Land and Water Science in Invercargill on physiographics. Physiographics uses high resolution spatial datasets to gain a deeper understanding of the role physical landscape characteristics, such as geology, soils, climate and hydrology, can play (in addition to land use) in driving spatial variation in freshwater quality outcomes. I was intrigued by the potential such tools could play in enabling more targeted policies to be developed for managing freshwater quality and soil greenhouse gas emissions. I therefore commissioned Land and Water Science to develop landscape susceptibility maps for two case study catchments: the Mataura catchment in Southland and the Northern Wairoa catchment in Northland.

[10] PCE, 2019a, p.156.

[11] PCE, 2018.

The next step was to consider the effects of different environmental policy settings in these catchments. I commissioned WSP and Nature Braid to model changes in land uses and land management practices in the Mataura and Wairoa catchments under six hypothetical policy scenarios, and to estimate the resulting environmental and economic outcomes. As part of the process, a series of hui and workshops were held in each catchment to discuss the policy scenarios and modelling assumptions, and to better understand the social and cultural considerations that could not be modelled. Additional work was also commissioned to highlight the perspectives of iwi and hapū from each catchment on these issues. The results of this exercise are published alongside this report.

The two case studies were designed to illustrate how a more integrated landscape approach could shed light on what different policy mixes might mean for the direction and scale of land use change. What the modelling delivered was striking.[12]

Based on current and forthcoming environmental and climate policy settings, our modelling projected that the Northern Wairoa catchment would – as a simple function of relative profitability – see a wholesale switch from sheep and beef farming to pine production forestry.[13] The scale of change was stark and came as a shock both to me and the local people who participated in the exercise. They expressed concern for their community about the loss of jobs and people that might result. They were also concerned about the impact of pine production of that scale on the landscape and environment. That said, they were also concerned about the costs of the status quo, particularly the destructive effect of sediment on water quality and mahinga kai – and ultimately the health of the entire Kaipara Harbour.

In the Mataura catchment, the same policy settings would also drive significant land use change – particularly the transition of hill country sheep and beef farming to pine production forestry. However, in contrast to Northern Wairoa, most dairy and lowland sheep and beef operations in the Mataura remained viable, albeit much less profitable. This highlights that the current national policy trajectory is likely to have significantly different outcomes depending on the context of the catchment and the farm systems located there.

The scenarios based on alternative policy mixes generated outcomes that were less extreme but still very challenging. From an environmental perspective, these alternative approaches showed that by sacrificing some carbon sequestration in the short term – pine is very fast growing – it is possible to generate better environmental outcomes for water quality and biodiversity. It is fair to say that the locals were still struck by the scale of land use change that was presented in these scenarios. However, they provided some assurance that a greater diversity of land uses could provide a more resilient local community, economy and environment. Unsurprisingly, communities reported that they were attracted by a process that gave them a greater say in the pace and direction of change.

[12] See PCE (2024) for detailed modelling methodology and results.

[13] In this report, 'pine' refers to radiata pine, which is the dominant pine species planted in New Zealand and makes up about 90% of our exotic plantation forests.

The case studies are not a forecast of the future for these regions and certainly not ones that can be extrapolated across the country. But in the process of developing them, it became clear that:

- the future will not look like the past
- the way we use the land is changing inevitably for a wide variety of reasons
- responding to environmental challenges will be one of the most important of those reasons.

Rather than draw conclusions from two case studies undertaken in very different regions, I decided to synthesise some key conclusions from the wider body of work I have undertaken. Modelling exercises can give a feel for the direction and scale of what may happen under different scenarios. But they omit as much as they include and cannot begin to sketch the ways people respond and adapt to change, new information and new technologies.

This document does not follow my usual investigative approach, which is to examine the evidence in detail to enable me to make reasonably granular recommendations. While the so-called 'wicked' problems it aims to tackle are well documented, the way forward remains mired in the political economy of conflicting interests that cannot be resolved from a purely environmental point of view. This report is as much about those conflicting interests as it is about the environment.

While attempting to tackle these problems we also must consider the position of whānau, hapū and iwi as kaitiaki and as landowners. Māori have a more holistic way of thinking about the environment. They assert that there is a lot to be learnt from a philosophy that protects the environment as a family member, not just a resource that can be traded at a price.

Some may be tempted to treat that as an unworldly view. It is not. Māori ag-related businesses we talked to are as pragmatic as any other players in the rural economy. But they start from a multigenerational standpoint. And they expect to be listened to by governments and regulators. Whatever lawyers may have to say about the reach of Te Tiriti in respect of whenua, wai and taonga, Māori represent by far the longest human link with many localities in rural Aotearoa. Māori knowledge must be part of all future landscape decision making.

This report tries to clarify the nature of the environmental challenges that rural New Zealand faces and ensure that those who determine public policy cannot claim they are unaware of the trade-offs they are confronting. Changing the way we use land cannot be avoided if only because current policies (particularly those governing climate mitigation) are actively encouraging it. My hope is that this report will give a sense of the possible direction of travel if New Zealand is serious about responding to the triple challenge of climate change, biodiversity loss and water quality in a way that maintains the economic, social and cultural viability of rural Aotearoa.

2

Cheilanthes sieberi ssp. *Sieberi*

Four critical problems confronting policymakers

This document starts from the assumption that we want to maximise the social, cultural and economic benefit of our natural resources while making sure that we look after them for future generations. My investigations suggest that policymakers confront four key problems that make this task a difficult one. They can choose to ignore them, but they will not go away.

Firstly, the way we use the land needs to change. The magnitude of environmental degradation in some parts of the country means that change in land use – not just management practices – is needed. Secondly, this situation is compounded by the reality that climate change itself is already and will increasingly become a driver of land use change as adaptation to a shifting climate becomes unavoidable. The third key problem is a fragmented policy landscape, where multiple streams of policy impact both directly and indirectly on decisions about land and water use. This fragmentation increases complexity and creates more uncertainty for landowners and kaitiaki. The final key problem is rooted in the fact that responsibility for environmental management is currently delegated to the owners of individual property while the consequences of many activities are variable, diffuse and catchment-wide. I will discuss each of these key problem areas below.

The way we use land needs to change

Past and present land use has had and will continue to have large and sustained environmental impacts, particularly in the form of greenhouse gas emissions, impacts on water quality and quantity, and on biodiversity. The impacts of land use activities on the environment of Aotearoa have been well documented in research and I shall only touch on some of the main concerns.

Greenhouse gas emissions from land use activities

New Zealand's contribution to global climate change is small on an absolute basis, but much larger on a per capita basis. The ongoing warming from the carbon dioxide released by historical deforestation is New Zealand's largest contribution to global warming, accounting for roughly three-quarters of New Zealand's current total warming contribution.[1] Today, fossil carbon dioxide emissions from transport, energy and industry are New Zealand's fastest-growing source of warming. But methane from agriculture, though plateauing over the last decade or so, causes more warming overall, accounting for twice as much of New Zealand's total contribution to warming as fossil fuels.[2] I have explored the warming contribution caused by methane and nitrous oxide emissions from livestock in New Zealand in a previous report – and it is considerable.[3] Reducing agricultural methane emissions, therefore, represents the greatest immediate opportunity to reduce New Zealand's contribution to warming.[4]

Degraded water quality

The quality of our rivers can be measured using five main indicators: phosphorus; nitrogen; clarity and turbidity; a macroinvertebrate community index; and *Escherichia coli* (*E. coli*). Data from Stats NZ show that the water in many of our rivers is in a degraded state, although some indicators are starting to show an improving trend.[5] Most of this degradation is a result of the way we use our land. That said, existing monitoring sites are unevenly distributed across the country and are not representative of all waterways.[6] Similarly, the quality of our groundwater is mixed. Existing monitoring of a limited number of sites suggests groundwater quality may be improving.[7] However, there is such a paucity of data on groundwater quality that it is difficult to make any definitive claims. What is clear, is that many of our catchments are not meeting the environmental bottom lines set out in the National Policy Statement for Freshwater Management.[8]

The Our Land and Water National Science Challenge has created maps estimating the catchments where the country's environmental bottom lines (set by successive governments) are being exceeded. They used results from the current monitoring network to model results for the whole country.

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1 Reisinger and Leahy, 2019, p.5. Land use change since human arrival to New Zealand has released around 12 billion tonnes of CO2. This CO2 continues to cause warming today (PCE, 2019a, p.66).

2 PCE, 2019a, p.80. This excludes the contribution to warming from historical deforestation, which dwarfs everything else.

3 PCE, 2019a, pp.79–80.

4 Barth et al., 2023, p.29.

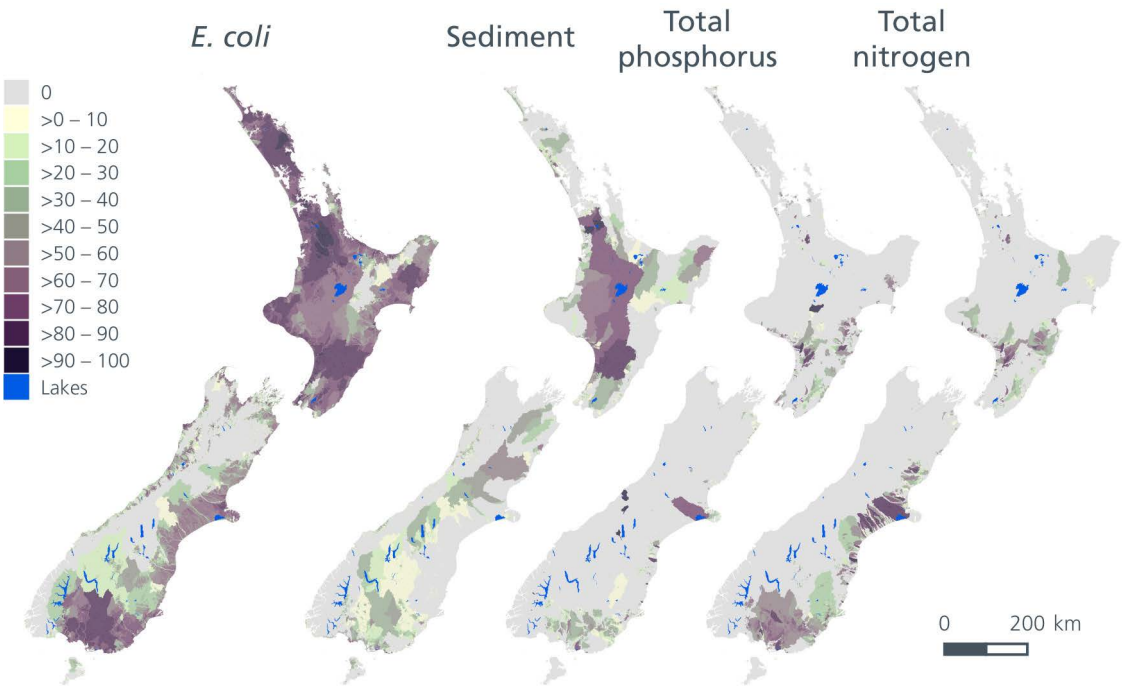
5 Stats NZ, 2022a, b, c, d, e.

6 For details, see PCE (2019b, pp.33–35).

7 Stats NZ, 2020.

8 MfE, 2024.

As Figure 2.1 shows, several catchments across the country exceed environmental bottom lines for one if not several contaminants. Some of these contaminants may be able to be reduced to stay within bottom lines by implementing on-farm mitigation measures, while in other places wholesale land use change will be needed.

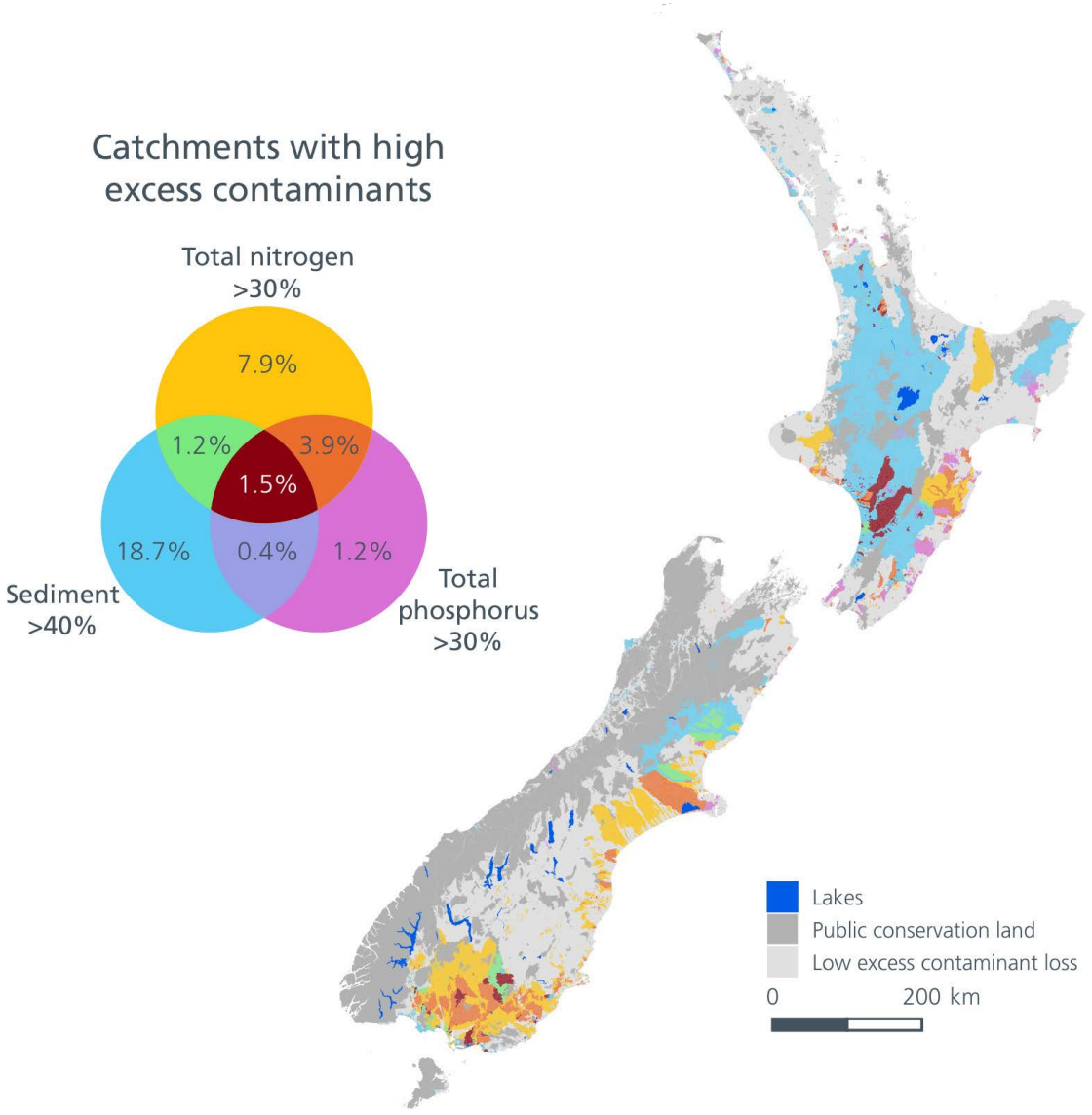


Source: Adapted from McDowell et al. (2021) and Snelder, Smith et al. (2023)

Figure 2.1: Map of catchments across the country showing the level of exceedance of current environmental bottom lines for *E. coli*, sediment, total phosphorus and total nitrogen.

Figure 2.2 presents a consolidated map that shows catchments with high excess contaminants that are beyond the levels that can be mitigated. Based on the available data, these catchments are likely to require land use change to achieve their environmental bottom lines.[9] This would affect about a third (34.8%) of catchments in New Zealand. In 1.5% of these catchments, all three contaminants mapped are in excess of these percentages. They are in parts of the Manawatū and Whangaehu catchments managed by Horizons Regional Council, parts of Waituna and Otapiri catchments managed by Environment Southland, and Otapiri catchment managed by Otago Regional Council.

[9] Using all established and developing mitigations available as of 2020, it would be possible to mitigate the impacts of existing land use in catchments where nitrogen and/or phosphorus is up to 30% above environmental bottom lines. In the case of sediment, the estimated figure is slightly higher at 40%. Where required reductions exceed these numbers, land use change is likely to be required. See McDowell et al. (2021) and Snelder, Smith et al. (2023).



Source: Adapted from McDowell et al. (2021) and Snelder, Smith et al. (2023)[10]

Figure 2.2: Map of catchments that will likely require land use change to meet environmental goals.

[10] The minimum acceptable states are determined by the national bottom lines for attributes as defined by Appendix 2A of the NPS-FM 2020 (MfE, 2024) that can be modelled in a consistent and comprehensive manner across New Zealand. This includes the nitrate toxicity, periphyton, *E. coli* and suspended sediment attributes for rivers, and the total nitrogen and total phosphorus attributes for lakes (Snelder, Smith et al., 2023). The thresholds for nitrogen, phosphorus and sediment are derived from McDowell et al. (2021).

E. coli was excluded from the consolidated map in Figure 2.2 because of the following issues with its monitoring:

- *E. coli* has a high natural background level in some catchments.[11] This can make it difficult to distinguish the impact of agricultural land use from urban land use. Consequently, it is difficult to attribute and determine the reductions required from different uses.
- Accurately understanding the concentrations of *E. coli* is difficult due to a combination of our relatively infrequent (monthly) monitoring and the fact that most *E. coli* is washed down rivers in times of heavy rainfall. Sampling frequency would have to at least double in most sites to detect changes in *E. coli* from any intervention.[12]
- There is limited understanding of the effectiveness of further mitigations to reduce *E. coli* losses.

Enhanced concentrations of *E. coli* are so pervasive across most of New Zealand that, in the absence of much better information on the sources of *E. coli* (e.g. sheep, cattle, deer, avian or human), it may not be a useful measure to use to prioritise areas for action. This is *not* a reason to stop regulating and managing *E. coli*. Instead, it is an argument for investment in more monitoring and research so that management can be effectively prioritised.

Freshwater currently needs to be maintained or improved to give effect to a hierarchy of objectives in Te Mana o te Wai designed to protect the mauri of the water (the new Government has signalled this hierarchy may change).[13] Giving effect to Te Mana o Te Wai and the required monitoring for this is new. However, monitoring programmes already developed by Māori to measure mauri show a degrading trend of water quality (e.g. Mauri Compass or Waikato River Authority taura).[14]

Reduction in water quantity

All human uses of freshwater have *some* environmental effects, including reducing or slowing flow, changing water temperature, reducing transportation of gravel or increasing pollution levels. Where these changes in water quantity impact on water quality they are implicitly picked up in the previous section. For our purposes here it is simply worth noting the interaction.

The main environmental impact of water use is where it results in a flow below the minimum needed for environmental functioning. Prominent examples are catchments in Canterbury where the use of freshwater has reduced the minimum flow to a level below that required for healthy ecosystem functioning, at least seasonally.[15] Data on water use has historically been poor, relying on consented takes, which often bear little resemblance to actual use.[16] Consents of consumptive water use (not including hydroelectricity use) total around 13 billion tonnes. Actual water use is likely to be less than this total. Recent legislative changes require regional councils to improve reporting of actual usage.[17]

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[11] McDowell et al., 2013.

[12] McDowell et al., 2024.

[13] See MfE and MPI (2020a).

[14] Benson et al., 2020; Waikato River Authority, 2016. For more examples of Māori monitoring tools, see Rainforth and Harmsworth (2019) and Stats NZ (2017).

[15] Note that this problem occurs to varying degrees in other parts of the country – for example, in parts of Central Otago. For more details on how overallocation is conceptualised and calculated, see Booker (2016).

[16] PCE, 2019b.

[17] MfE and MPI, 2020b.

Loss of biodiversity

Owing to its geographic isolation, Aotearoa is home to a high number of endemic species.[18] These species (and others) are threatened by loss of habitat and competition from over 80 exotic animal species and, as of 2020, just under 1,800 plant species that have been introduced and naturalised since human arrival.[19] This has resulted in the extinction of at least 81 animal and plant species, including 62 bird species. More than 75% of indigenous species are threatened with extinction or are at risk of becoming threatened. They include 94% of reptiles, 82% of birds, 80% of bats and 76% of freshwater fish.[20]

Before human arrival, 80% of the land was covered with native forest.[21] By 2018, this was down to 27%. This loss continues. Between 2012 and 2018, indigenous land cover area decreased by 12,869 hectares.[22]

Wetlands provide enormous ecological, economic and wellbeing benefits. They are seen by some hapū as the lungs of Papatūānuku.[23] In pre-human times, wetlands covered almost 2.5 million hectares of Aotearoa.[24] By 2008 this area had been reduced to 250,000 hectares or roughly 10% of their original extent.[25] Wetland loss has continued since then, with the area of freshwater wetland decreasing by 1,498 hectares (0.6%) between 2012 and 2018, and saline wetland decreasing by 69 hectares (0.1%) over the same period.[26] The previous Government introduced a "no further loss of extent of natural inland wetlands" policy, but it is too soon to see if this was effective in halting the decline.[27] It would be helpful if the tax system were aligned with this policy; currently, it is still possible for farmers to write off the earthworks associated with draining wetlands.[28] It is not only the losses in extent that matter, but also the health of any remaining wetlands.

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[18] Endemic species are those found only in Aotearoa.

[19] Brandt et al., 2021

[20] Stats NZ, 2023b.

[21] Stats NZ, 2015.

[22] Stats NZ, 2021b.

[23] Sustainable Kaipara, 2022.

[24] Stats NZ, 2018.

[25] Stats NZ, 2018.

[26] Stats NZ, 2021c.

[27] Policy 6 of the NPS-FM 2020 (MfE, 2024).

[28] Farmers can claim an amortisation of 5% per annum on a range of farm development expenditures, including the draining of swamps and low-lying land. See Brenton-Rule et al. (2019, p. 23).

Summary

This catalogue of ongoing environmental degradation is a direct result of the way we have used the land in the past and the way we continue to use it. Present day pressures are added to the legacy of past land use choices. We will need to make further changes to the way we use the land if we are to halt any further decline.

This is not only important to achieve our environmental goals. It has a large economic component. Most environmental impacts of land use activities do not currently appear as costs in the production process, yet they should. Conversely, the activities landowners undertake to improve the environment should be rewarded economically, yet generally they are not. In a recent report, the Food and Agriculture Organization of the United Nations used a true cost accounting approach to estimate the cost of the hidden environmental impacts of New Zealand's food production. It put the total at over $14 billion.[29] Eventually we all bear these costs as a degraded environment impacts on our quality of life and the productive capacity of the land.

Large numbers like $14 billion can be dismissed as an artefact of the methodology that generated them. But measures like these are increasingly informing the decisions of consumers and food processors on whom we rely for a significant chunk of our national income.[30] The future will be one in which more questions are asked about the way we produce food and fibre, and more accountability demanded from producers.

The empirical record of how we use the land and what that means for environmental quality will not be able to be as easily sidelined as it once was. Getting land use onto a more sustainable basis will mean embracing a spectrum of land use changes. In some cases, applying mitigation techniques to existing land uses may be enough to achieve our environmental goals. In other cases, wholesale land use change will be necessary.

A changing climate is re-dealing the cards

Climate change itself will increasingly be a driver of land use change as landowners adapt to shifting climatic conditions. We have some idea of how average warming trends will impact on land use.[31] But the big unknown is the impact of extreme events.

In terms of average trends, Aotearoa is getting warmer.[32] As a result of this trend, droughts have become more frequent while frosts are rarer.[33] Changing temperatures are likely to favour incursions by new pests and diseases and the rapid spreading of existing ones.[34]

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[29] New Zealand dollars (converted from 2020 purchasing power parity (PPP) dollars). FAO, 2023, p.100, see environmental hidden costs.

[30] See SBTN Freshwater Hub (2024).

[31] See, for example, the Data Supermarket website (https://landuseopportunities.nz/).

[32] MfE and Stats NZ, 2023, p.23.

[33] Stats NZ, 2023a, c.

[34] Phillips et al., 2023.

Notwithstanding these average trends, the forecasts for New Zealand agriculture are *relatively* positive in economic terms. A changing climate is likely to open new opportunities for land use.[35] Studies predict improvements in primary productivity of between 1% and 10%. Our international competitors are likely to be impacted more negatively, leading to higher international commodity prices.[36] Depending on which sectors are most affected, this is likely to create an incentive for even more intensive land use.[37] Without mitigating measures in place, more intensive land uses could have further negative impacts on the environment.

It is more difficult to predict the impact of extreme weather events on the way we use the land. There is a clear upward trend in both the declarations of states of emergency and insurance payouts for weather-related events.[38] This trend is likely to continue with droughts, fires and floods all becoming more extreme when they happen and possibly more common. There will be some unpredictability in how and when such extreme events manifest. As a result, landowners will likely have to face new extreme events while still recovering from previous ones. A possible consequence will be commodity price volatility as landowners, and particularly farmers, are confronted with increasingly extreme weather patterns that unpredictably affect production and yield.

Understanding the risk of these extremes is a relatively new area of research and requires modelling of the potential impacts of extreme events at very local levels. Models such as RiskScape are an example of this.[39] The next step in research will be to understand the costs and benefits of potential investments in disaster mitigation.

Research is currently being undertaken to examine the implications that climate change holds for land use change.[40] It explores where in regions climate change will drive land use change, identifies the land use options in those areas, and models the regional and national economic effects of those shifts. The research will use downscaled climate projections for New Zealand, which will include a range of weather patterns. It will not explicitly examine extreme events. This research will be complete in 2025.

A separate recent study has investigated the impact of extreme sea level events and relative sea level rise on the viability of dairy operations and their exposure to coastal inundation. It shows that even with a conservative estimate of 0.5 metres of relative sea level rise over the next century, 4–7% of dairy farms are likely to need to change their land use in some shape or form. In some areas that figure is higher – for the Waikato it is 8–10%, with significant areas of the Hauraki Plains likely to be at risk.[41]

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[35] OLW, 2023.

[36] See Jägermeyr et al. (2021).

[37] Rutledge et al., 2017.

[38] Carbon News, 2023.

[39] Jointly funded by NIWA, GNS Science and Toka Tū Ake EQC. See https://riskscape.org.nz.

[40] The research is being undertaken by Manaaki Whenua – Landcare Research, Plant and Food Research, Scion and NZIER.

[41] Craig et al., 2023 (see supplementary data). Note that the modelling does not account for potential flood mitigation.

The previous Government developed a national adaptation plan,[42] but we have little detail on its implementation. Government responses to the storms in Auckland, Hawke's Bay and Tairāwhiti over the summer of 2023 and Nelson in 2022 have potentially set precedents for how we respond to such events. These precedents include compensation for home and landowners in high-risk flood areas. The Ministerial Inquiry into land use causing woody debris and sediment-related damage in Tairāwhiti and Wairoa during Cyclone Gabrielle also includes the proposal for a new category for land with 'extreme erosion susceptibility' within the Erosion Susceptibility Classification and investigating an appropriate management response (such as permanent canopy cover).[43] The Government's response to the Ministerial Inquiry agreed in principle with this recommendation, noting that Gisborne District Council is already intending to address this issue through a plan review.[44]

Also relevant for farming is the recommendation of the Expert Working Group on Managed Retreat that compensation for commercial buildings be means tested and capped at a lower proportion of the value than the compensation for homeowners.[45] It is worth noting that the Government is developing a National Policy Statement for Natural Hazard Decision-making to respond to the increasing risk of climate-related disasters.[46]

In sum, climate change will force some changes in the way we use the land as temperature and seasonality shift, and in some regions extreme events will make some land uses untenable. Some new land uses may become possible; some will be made inevitable. Land values will be affected, in some cases seriously. At this point, it is unclear who will bear this burden, but in the absence of any public intervention it will be the landowner.

The policy landscape is fragmented

A further challenge is the sheer scale and complexity of environmental regulation either in existence or under development. Regulation of the environmental impacts of land and water use will always be complex to some degree. This is probably unavoidable. However, this complexity is increased by the fragmented nature of the current regulatory approach. There are multiple streams of policy work that directly impact decisions about the use of land and water. From the perspective of farmers, these policies appear to have all landed on their kitchen table at the same time.

This situation is unquestionably a source of uncertainty and becomes, in turn, an additional barrier to land use change. Uncertainty about the scale and timeframes of the required changes and the ways different regulations interact with one another makes it more difficult for landowners to make the large investments required to change land uses. After all, why would a farmer make an investment when it is unclear whether it will help them comply with regulations?

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[42] See MfE (2022).

[43] See MILU (2023).

[44] See Office of the Minister for the Environment and Office of the Minister of Forestry (2023).

[45] EWGMR, 2023.

[46] MfE, 2023b.

For landowners, mana whenua and communities on the ground, this fragmentation increases the complexity of responding to regulation. It can be unclear how these policies fit together; and there is a risk that sometimes they will pull in different directions.[47]

Beyond being complex, these policies tend to have lag times – sometimes several years – between development, implementation and response. While these policies need to be customised to local circumstances, different approaches to implementation by regional councils can add another layer of complexity. To that complexity is added the need to ensure that Māori can engage both in terms of developing regulations and implementing them. As a Treaty partner (under Article 2 of Te Tiriti o Waitangi), Māori assert a right to practise kaitiakitanga in the protection of their taonga like freshwater within their rohe. Māori are also landowners who will have the same responsibilities as other landowners to protect taonga as well. While the way this is done varies around the country, there is a need to support this participation across the board.

Regulation of the environmental effects of land and water use has been a dynamic space in recent years. Different issues (such as carbon, fencing rivers or nitrogen leaching) have become the myopic focus of central government at different times. Every time a policy is reviewed or updated, or a potential change of government signals change, uncertainty reverberates through communities of land and water users, affecting their decisions. In a recent Survey of Rural Decision Makers, four in ten respondents said they struggled with constantly shifting goalposts.[48] The complexity of environmental regulation is described in further detail below.

Policies that influence land use

Central government has developed separate policies for climate change, freshwater quality and biodiversity. All these policies have the potential to significantly influence decisions related to land use and land management practices. From a landowner or kaitiaki perspective, it is difficult to see how these policies fit together cumulatively at a catchment or landscape scale. Table 2.1 provides some examples of the different policies and how they influence land use.

[47] Research is being undertaken to investigate tensions that arise between water quality and greenhouse gas regulations, in relation to housing livestock within off-paddock herd homes during wetter winter periods. The practice of housing livestock improves water quality but potentially increases greenhouse gas emissions. See Morris and Lowe (2024).

[48] Stahlmann-Brown, 2023.

Table 2.1: Some examples of climate change, freshwater and biodiversity policies that influence land use

Theme	Policy	How the policy influences land use
Climate change	New Zealand Emissions Trading Scheme (NZ ETS)	Provides financial rewards for planting forests that are based on annual carbon sequestration rates. People have predominantly planted fast-growing, exotic tree species to accumulate more sequestration units quickly, and there are proposals to recognise smaller on-farm plantings.
	Levy on agricultural greenhouse gas emissions (delayed to 2030)	Puts a price on biogenic methane and nitrous oxide emissions from farms. This could encourage farmers to reduce their emissions by decreasing stock numbers, changing management practices, diversifying their farm system, and/or adopting new technologies.
	Support for research, development and commercialisation of tools and technologies to reduce emissions	Accelerates progress on tools and technologies that enable landowners and kaitiaki to reduce their greenhouse gas emissions. This could reduce the amount of land use change required to meet emissions reduction targets.
Freshwater quality	National Policy Statement for Freshwater Management*	Requires freshwater to be managed in a way that gives effect to Te Mana o te Wai and protect its mauri. Establishes national bottom lines for water quality in rivers and lakes and requires regional councils to engage with tangata whenua and communities. It also requires regional councils to set visions, objectives and targets for specific freshwater attributes and contaminants, and to set rules, limits and methods for achieving these visions, objectives and targets.
	National Environmental Standards for Freshwater*	Sets national requirements for carrying out certain activities that pose significant risks to freshwater quality and freshwater ecosystems. These include rules relating to: • conversions of pine production forestry to pasture • conversions of farmland to dairying • irrigation of dairy land • intensive winter grazing • application of synthetic nitrogen fertiliser to pastoral land • natural inland wetlands • fish passage.
	Stock exlusion regulations*	Prohibit the access of cattle, pigs and deer to wetlands, lakes and rivers.
	Freshwater farm plans*	Requires most farms to have a freshwater farm plan that identifies risks to freshwater quality and actions that will be taken on farm to mitigate these risks, in the context of the catchment in which each farm sits.

Biodiversity	Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy and its implementation plan	Sets the strategic direction for the protection, restoration and sustainable use of biodiversity over the next 30 years. The implementation plan is a 'living' document and allows for five-yearly reviews.
	National Policy Statement for Indigenous Biodiversity*	Recognises the role of landowners and tangata whenua as stewards and kaitiaki of indigenous biodiversity. The Resource Management Act 1991 requires councils to identify significant natural areas and make plans to manage them. The national policy statement provides a consistent method of identifying and protecting significant natural areas across regions. Crucially, these areas can be on private land. Separately, the Government is also exploring a biodiversity credit system.
Cross-cutting	National Policy Statement for Highly Productive Land	Requires that highly productive land is protected for use in land-based primary production, both now and for future generations. It requires regional councils to identify (map) highly productive land in their regions and manage that land in an integrated way that considers the interactions with freshwater management and urban development. Specifically, it requires highly productive land to be protected from inappropriate use and development, and to be prioritised for land-based primary production.
	The National Policy Direction for Pest Management	Sets out the responsibilities and requirements for central and local governments to manage unwanted organisms, including pests and weeds already in the country. It also sets up a framework for preparation of various management plans.
	National Environmental Standards for Commercial Forestry	Sets nationally consistent standards to manage the environmental effects of eight core forestry activities for both pine production and carbon forests (afforestation, pruning and thinning, earthworks, river crossings, forestry quarrying, harvesting, mechanical land preparation and replanting), sets out clear rules for any harvests that happen in carbon forests, and sets a new permitted activity standard for managing forestry slash on the cutover.

* Denotes policies that have recently been identified for further review.

As noted above, climate adaptation will inevitably (over time) form another layer of policy that impacts on land use.

The Government also has responsibilities to all Māori under Te Tiriti o Waitangi as well as those set out in individual Treaty settlements relating to tino rangatiratanga and kaitiakitanga, and how to include tangata whenua in local policy and regulatory processes. Operationalising these responsibilities is always likely to be challenging given the differences in worldview between te ao Māori and a mixed market economy based on the paradigm of individual property rights.

Fragmentation extends to funding land-based activities

In addition to their policy and regulatory settings, successive governments have presided over the emergence of a thicket of funding programmes for landowners and kaitiaki. New Zealand's agribusiness sector likes to think of itself as sturdy and subsidy free. The truth is a little more nuanced. Taxpayers have in fact spent an average of just under $700 million per year supporting the sector (as set out in Table 2.2). In addition to this figure, on average, around $170 million is spent every year on generic biosecurity; an investment that benefits agriculture.

Table 2.2: Expenditure for the land-based food and fibre sector over the last four budget cycles.[49]

Category	2020/21 $(000)	2021/22 $(000)	2022/23 $(000)	2023/24 $(000)
Administration, supervision, regulation, and policy advice	140,345	166,494	229,230	261,390
Research	62,586	60,917	83,341	72,815
Trade promotion and industry development	21,525	22,804	21,630	20,398
Knowledge transfer and farm advice	800	800	9,102	6,857
Grants, loans, subsidies, and co-funding	133,458	135,852	227,270	277,942
Assistance for exceptional events (COVID-19, extreme/ adverse weather events, etc)	12,115	7,798	93,234	16,267
Biosecurity	124,816	92,946	178,298	49,998
Animal welfare	18,560	19,713	17,268	24,177
Support for whenua Māori	7,979	9,309	6,303	7,438
Total	**522,184**	**516,633**	**865,676**	**737,282**

Note: Individual figures may not sum to stated totals due to rounding.

[49] The Treasury, 2023; MPI, pers. comm., March 2024; Te Puni Kōkiri, pers. comm., March 2024.

There is nothing in principle wrong with public funding for the land-based sector. There are types of expenditure that are hard for individuals to undertake because they cannot capture the benefits – the goods produced are 'non-excludable'. Funding for research and development to facilitate the innovation and diffusion of technologies that may not yet have a foothold in the market falls into a similar category. It makes sense to fund these public goods and services provided the benefits are sufficient to justify the outlays. In making the case for continued taxpayer provision of these goods and services, agribusiness needs to ensure that its social licence to operate aligns with ongoing taxpayer support. In blunt terms, agribusiness cannot decide to socialise the environmental cost of its operations but seek support for the provision of public goods that will increase private profits.

Many of these taxpayer-funded schemes are related to reducing emissions, improving freshwater quality and protecting or enhancing biodiversity. A selection of these is illustrated in Figure 2.3. Like the national policies outlined above, these funding programmes are often fragmented in the sense that they target a specific policy outcome even though they have co-benefits across domains.

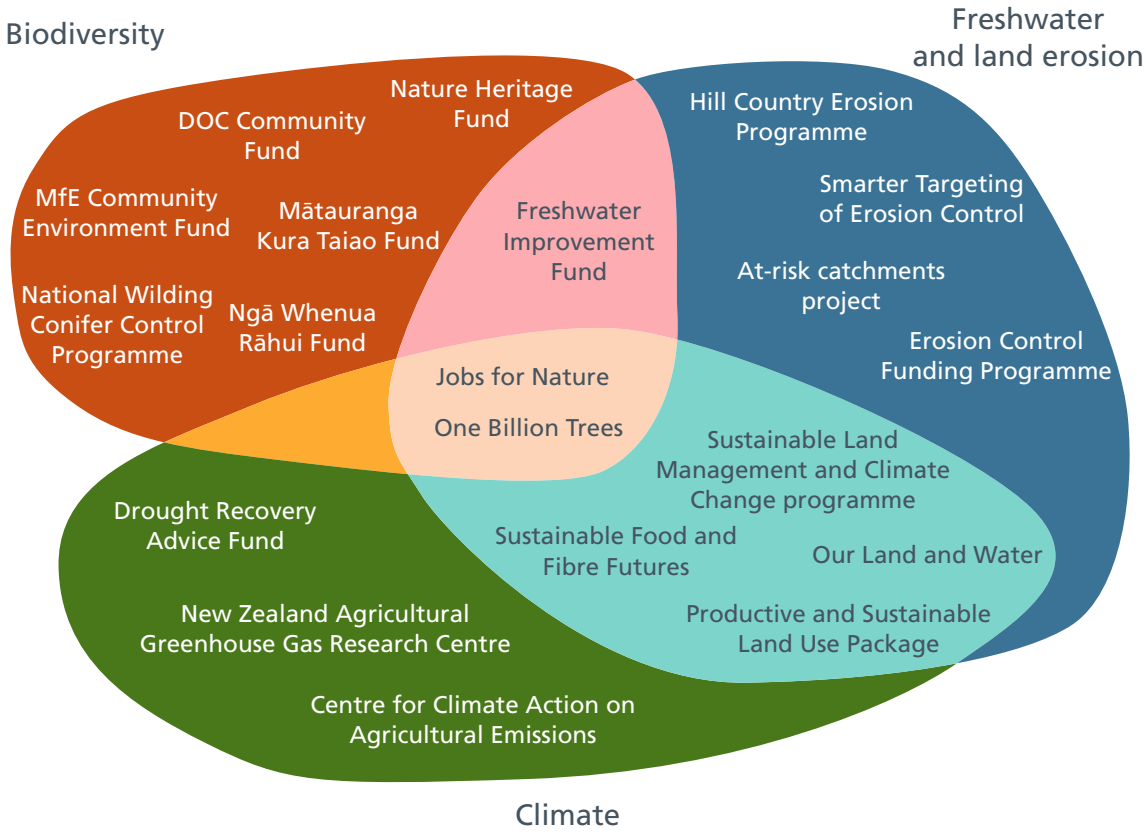

Figure 2.3: Examples of past and present funding programmes related to climate change, freshwater and land erosion as well as biodiversity.

In addition to the climate, freshwater and biodiversity policies and funding outlined above, the Government has separate policies aimed at enabling Māori to unlock the potential of their whenua. For example, the Whenua Māori Service provides access to a network of regional whenua advisors, and the Whenua Māori Fund provides financial support for activities to develop whenua Māori. The focus of these policies is generally on improving the productivity of Māori land.[50]

As the patchwork of policies and funding outlined above expands, it is becoming increasingly difficult for landowners, catchment groups and kaitiaki to navigate them. It is also increasingly challenging for officials from different ministries to coordinate and align the many moving parts. Further, it is difficult for parliamentarians to hold ministers and agencies to account for whether they are making a difference. Finally, there is a risk of imbalances between different policy areas, which can lead to negative unintended consequences for the environment. For example, the current strong focus on offsetting carbon emissions with forests increases the risk of land use decisions being made that are suboptimal for freshwater quality, indigenous biodiversity and climate change adaptation.

The limitations of property-based management

Many of the environmental impacts of land use are difficult to measure, do not respect property boundaries, and make attribution challenging. A focus on farm-level or individual-level responsibility leads to solutions based on property boundaries. Some property boundaries are aligned with geographic features of the landscape such as waterways or ridge lines, but many bear no relation to the grain of the land. As a result, in the absence of cooperation with neighbours and others sharing the same catchment, any individual can only have a limited impact on improving freshwater quality or biodiversity.

Under our current system, decisions about land use are largely in the hands of landowners, within regulatory constraints originating from the Resource Management Act. The domain of landowners is denominated by property boundaries. In theory, positive and negative externalities should be internalised in the costs of business operation via market-based mechanisms (including prices, taxes and subsidies). Or, in more colloquial terms, polluters should pay for the impact of their activity on the environment, and that money should be used to clean up the mess. Pollution is not always easy to measure. But in those cases where impacts can be accurately measured and attributed, market-based mechanisms can be adopted. This will be discussed in the next chapter.

However, in many cases the sheer complexity of environmental impacts can make it difficult to pinpoint the origin of and responsibility for environmental problems at a property level. It also makes it difficult to incentivise land use change when the benefits from such change generally do not map neatly onto property boundaries.

[50] TPK, 2023a, b.

For example, climate emissions are difficult to apply accurately on an individual farm basis unless the animals are kept inside. In the case of the levy on agricultural emissions, as proposed by the previous Government (the current Government has delayed implementation to 2030), the primary point of obligation lies at the farm level, though levy payers might be permitted to fulfil their reporting and payment obligations as a collective.[51]

Biodiversity (both flora and fauna, native and introduced) is also capable of moving around, often crossing property boundaries.

And of course, the impacts on water quality downstream of a certain land use depend very much on the soil type and hydrology of the area. Some activities, such as intensive winter grazing or cropping on vulnerable land classes, pose a high risk to receiving environments yet they have become normalised. Impacts also vary strongly because of climate and weather patterns, making it difficult to discern trends. While the environmental impacts of land use on water quality become more obvious as catchments get closer to the sea, accurately attributing those impacts to individual landowners is very complex.

These challenges are only likely to grow with the impact of climate change introducing increasing uncertainty into environmental flows and management decisions. Extreme weather events are likely to make the interdependencies between the actions of different landowners in a catchment even more stark. This will only heighten the positive and negative externalities of different land uses.

As a result, it is difficult to accurately measure and attribute environmental damage (or benefits) to land use choices made by individual landowners, except in the most extreme circumstances (such as discharging effluent into rivers, or winter cropping on steep slopes). This in turn makes it difficult to either incentivise or compel landowners to reduce their damage in an enforceable way. Instead, models are used to attribute environmental damage to individual farms.

In freshwater management, for example, the focus is on farms and farm-level measurement and management. Each landowner is technically responsible for the flows of contaminants lost from their land, often regardless of the fate and cumulative effects of these pollutants once they cross the property boundary or seep beneath the root zone. The Ōtūwharekai Ashburton Lakes provide a troubling example of what can happen if insufficient attention is paid to these cumulative effects. In this case, nitrogen-loss limits were set based on the past practices of individual farms (i.e. they were grandparented) rather than the ecological requirements of the lakes themselves. This resulted in nitrogen-loss discharges above what the lakes could tolerate, leading to a significant decline in water quality.[52]

[51] MfE and MPI, 2022.

[52] MfE, 2023a.

The difficulties of attributing environmental outcomes from land use at the property level have contributed to the creation of freshwater farm plans. In general, regulation is costly to implement and enforce and therefore tends to be focused on the laggards in any industry. When attribution is difficult, regulatory enforcement is even more complex. Farm plans are a risk-based regulatory tool that focus on actions to reduce each farm's potential impact on freshwater, in the context of the catchment in which each farm sits. This could be a promising way forward, provided that (1) there is sufficient capacity for implementation, (2) the plans focus on material issues (rather than resorting to box ticking), and (3) there is a basis of good information to underpin the exercise (which will be discussed in the next chapter).

Māori land presents additional unique issues

Māori have strong connection to the whenua through whakapapa and their collective responsibility to the land. Despite the Treaty of Waitangi, forced land sales and confiscations diminished the ability of Māori to exercise tino rangatiratanga and kaitiakitanga over their land and waters. Settlement agreements and Te Ture Whenua Māori Act 1993 are attempts, with variable success, to redress these losses (but see Box 2.1 for two examples of Māori businesses attempting to do so). These unique circumstances mean Crown policies that – directly or indirectly – influence land use change need to be carefully managed to ensure they do not further disadvantage or alienate Māori and Māori land. Targeted policies and funding mechanisms are needed to ensure Māori can manage their land on an equal footing with other landowners.

Settlement agreements

Through settlement agreements, iwi have been given a small fraction of their land back, either through gifting or purchases from the Crown. Many of these parcels included former Crown forestry licensed land, including pre-1990 exotic forests. Due to these parcels being excluded from gaining carbon credits in the NZ ETS, investments back into the land, including for environmental purposes, have been difficult. Other parcels included land that was already established in agriculture or horticulture. Many iwi are reclaiming their rangatiratanga and kaitiakitanga by changing land use to more environmentally friendly purposes and through the use of te ao Māori business frameworks. Two examples are the Māori-owned businesses Parininihi ki Waitōtara and Miraka (see Box 2.1).

Box 2.1: Attempting to improve Māori land use

Parininihi ki Waitōtara Inc

Parininihi ki Waitōtara is a Māori incorporation that administers approximately 21,000 hectares of diverse land use, predominantly ahuwhenua, in Taranaki. It has circa 11,000 shareholders who whakapapa to the land.

The land is looked after for the collective benefit of its people, and the Committee of Management's business strategy has a multigenerational outlook. Its vision – He Tangata, He Whenua, He Oranga – is measured through its bottom line and its enterprise operations, utilising Te Ara Putanga, its kaupapa evaluation tool. This tool helps them to assess whether they are achieving their core values of manaakitanga, kaitiakitanga, whakapono and whanaungatanga/kotahitanga.

Parininihi ki Waitōtara invests in the restoration and care of the whenua through supporting the development of hapū-led water monitoring programmes, species protection and capability building.[53]

Miraka

Miraka was established in 2010 by a group of Māori trusts and organisations with significant land assets and farming operations in the Central North Island. It is the first Māori-owned dairy processing company in Aotearoa and is powered by geothermal energy.

Establishing a dairy processing operation on their own land corresponds to a long-term intergenerational view of 100 farms for 100 years, with a prosperous outcome for their communities and shareholders. Miraka is founded on te ao Māori values, and kaitiakitanga is at the core of the business. Values of tikanga (protocols), whanaungatanga (relationships), and kotahitanga (collaboration) are part of the company's business strategy. The intention is to support their suppliers in achieving these values as well. Being a processing plant, Miraka can only encourage its suppliers to uphold these fundamental values. It is ultimately up to the suppliers to balance these values against the sustainability of their business.

To support the implementation of its core values, Miraka has developed its Te Ara Miraka farming excellence programme, which incentivises best practice on farm. The programme incentivises suppliers to achieve certain standards, including environmental stewardship. The Farm Sustainability manager at Miraka helps suppliers to stay ahead of environmental regulations as well as supporting a kaitiakitanga focus covering, for example, support on effluent management, riparian planting and reducing nutrient losses.

Many of Miraka's suppliers have diversified land portfolios outside of their dairy farming businesses (predominantly the Māori trust suppliers) while across their supplier base some of their farmers have explored other farm systems, including regenerative farming. This is not an easy task for landowners who need to find profitable uses for land that may originally have been used for unsustainable purposes such as dairying on high-leaching soils.[54]

[53] Parininihi ki Waitōtara, 2016.

[54] Miraka 2021; Miraka, pers. comm., November 2023.

Much of the settlement land is marginal in terms of economic productivity because of poor soil quality or steep slopes. Furthermore, many pockets of Māori land today are landlocked, or have been identified as important native bush. Where that marginal land is running sheep and beef, policies that add additional costs, such as an emissions levy, may disproportionately affect Māori owners. For Māori landowners, options to make an economic return on that land are mostly limited to forestry. Policies that then limit forestry's potential on that land risk further disadvantaging its Māori owners. Even retiring 'marginal' land can be difficult. For example, converting land to native forest as an exercise of kaitiakitanga would provide cultural and environmental benefits but requires funding to do it.

Māori land

Māori freehold land governed by Te Ture Whenua Māori Act 1993 is collectively owned through whakapapa and succession. The Act sets up collective ownership, where many people 'own' the land. To manage those multiple owners many iwi and hapū have set up management structures like a trust or an incorporated society.[55] By area, 83% of Māori land blocks are now under whānau management. Many of these trusts or organisations are working towards self-determination of their lands and trying to implement te ao Māori frameworks to manage them, but they face challenges.

While the provisions of the Act protect descendants from further alienation, they reduce the options Māori have to manage the land economically and restrict options for land use change. Decisions to develop, use or change the land with multiple 'owners' require collective agreement, which is often hard to win even with a trust or incorporated society structure. Land cannot be used as an asset to borrow against, thereby restricting Māori from easily developing their land or making the transition to more environmentally sustainable uses. Restrictions in place reduce the ability to transfer ownership outside of the owners' whānau, hapū or descendants.[56] While Māori land can legally be sold, many Māori object to sale of land they are connected with through whakapapa, even if the land generates poor returns. As a result, these administrative challenges make transitioning to alternative land-use approaches difficult. Public policy initiatives that provide support for administering whenua Māori and targeted initiatives for supporting Māori agribusiness are essential.

[55] Community Law, 2024.
[56] Community Law, 2024.

3

Cranfillia deltoides

What would be needed to do a better job?

How – or even if – we go about tackling the environmental challenges outlined in chapter two is a matter of political judgement, as is the question of who pays. None of this happened yesterday and it will only be addressed over a time frame better measured in decades rather than parliamentary terms.

From the protestations of all politicians, I have to assume that people want to halt the decline in environmental quality and, if possible, improve it. Regardless of who pays for the transition to a more resilient landscape, we need to change the way we are approaching the problem. It is important that we view the environmental impacts of land use not as a series of technical problems (climate mitigation, climate adaptation, freshwater quality and biodiversity) with discrete solutions – as has often happened in the past. In academic jargon this is called an *adaptive challenge*.[1] In practical terms it means facing the fact that natural and rural environments are complex systems (with all sorts of feedback loops) and so are the rural communities who live there. So, any policies should be written in the full knowledge that there will be a need for constant adjustments as we learn more about the way those complex systems are responding – or are not. Simply put, we must *continually adapt our land management and land use choices in ways that are appropriate to the landscape and local communities*.

For some years I have been calling for an **integrated approach** to thinking about the environmental impacts of land use. I have not been alone in this.[2] By integrated, I mean considering the impact of land uses and changes to those land uses all at once rather than treating 'integration' as the sum of a whole series of separate exercises.

[1] "Adaptive problems are often systemic problems with no ready answers" (Heifetz and Laurie, 1997, p.124).

[2] See MILU (2023).

Part of the reason I undertook case studies in two catchments was to test this proposition (see Box 3.1). The experience convinces me that the approach is worth pursuing. For instance, I found that by sacrificing some of the short-term benefits of carbon sequestration, it was possible to create a more diverse landscape with environmental benefits that reinforce one another.

Another benefit of this approach is that it creates multiple income streams from a range of land uses, as integrated approaches are more likely to produce diverse land use mosaics.[3] Such an approach could help the people who live in our landscapes to be more resilient to external shocks. By contrast, I found that the current approach is likely to result in less diverse landscapes (mainly dairy farms and pine production forests).

Most people I have talked to agree that an integrated approach would be an appropriate way forward. In fact, nobody has seriously challenged this proposition. But 'integration' is one of those words that is easily trotted out to give the appearance of holism while practical day-to-day matters remain siloed. The question is, how in practice could that work?

The answers to that question lie, in part, beyond my remit and raise questions about the structure of government and the levels at which initiatives can be taken. However, four issues are worth exploring here:

- the appropriate scale for integration
- the availability of reasonably granular, high-quality information that can make links between the ambition of proposed changes to land management and land use, and environmental outcomes
- the way communities are engaged and the extent to which decision making is devolved
- the financial resourcing needed to fund all of the above.

Each of these is explored in turn below.

[3] MILU, 2023.

Box 3.1: Findings from two case studies[4]

The integrated exercise undertaken for the Mataura catchment in Southland and the Wairoa catchment in Northland illustrated how the impacts of environmental policies are likely to vary considerably from place to place. For example, modelling a low levy on agricultural emissions indicated a minimal impact on land use in the Mataura catchment between now and 2060. By contrast, in the Wairoa catchment, it would be likely to trigger a significant amount of land use change, with most hill country sheep and beef farms and even some dairy farms converting to forestry.

The modelling also illustrated how in the absence of changes to the role of forestry in the NZ ETS, the combination of a medium levy on agricultural emissions and a rising NZ ETS price would be likely to result in less diverse landscapes by 2060, with most of the land in these two catchments used for pine production forestry, dairy farming or (in the case of Mataura) lowland sheep and beef farming. Fast-growing pine forests can remove significant quantities of carbon from the atmosphere, and soil losses from forests are generally lower than losses from pasture. However, if clear-felled, the exposed land is left particularly vulnerable to erosion during the period following harvest. Discussions with people living in these catchments also highlighted that converting large areas of land to pine production forests to earn carbon credits could have negative local social and cultural impacts.

The exercise also considered what might happen if a more nuanced, place-based mix of policies were implemented. Alternative policy scenarios were developed in a series of hui and workshops with local people in the catchments. In these alternative scenarios, the revenue from a levy on agricultural emissions was recycled back to the catchment it came from and spent on actions to address multiple environmental pressures.

The modelling highlighted the importance of identifying 'hotspots' – areas in the landscape that are responsible for a disproportionate impact on the environment. These hotspots are a result of the characteristics of that land and the way it is being used. Farmers and advisors will be familiar with the term 'critical source areas' (areas of a field, farm or catchment that account for the majority of contaminant loss to waterways), which are an example of a hotspot. Targeting and taking action on hotspots will have disproportionate benefits for the environment. In the modelling, examples included fencing off waterways and riparian planting, gully planting, scaling up alternative land uses on hotspots, and restoring and constructing wetlands.

The case studies also highlighted the importance of engaging mana whenua early in any process to better understand landscapes and land use from a Māori perspective. Not surprisingly, both mana whenua groups decided to represent their intergenerational connections and the application of their mātauranga in very different ways. It was communicated by both that this relationship cannot be severed or reduced. Any exploration on changing land uses to implement multiple environmental policies needs to ensure Māori ways of knowing and understanding catchments are integrated into the purpose, outcomes, methodology, etc of the approach. This is much more easily achieved at the local level.

[4] PCE, 2024.

Appropriate scale for an integrated approach

The manifestation of many environmental stresses is very often place-specific. This means they cannot easily be handled effectively by national-level regulation. Decisions need to be taken much closer to the land uses that are generating them. This makes actions like the implementation of strategies to mitigate contaminant loss from land to water much more cost-effective than relying on cleaning up contaminants downstream.[5] Any attempt to **integrate** a response to the impacts of land use change on the environment in a holistic way will run up against individual property rights. The bundle of rights that attach to land ownership are likely to remain a cornerstone of our society. Those rights are not immutable, but attempts to regulate that cut across them need to be compatible with them.

Input regulations are a good example; they are blunt and much derided by farmers as telling them what to do on their own land. But if farmers cannot control the impact of activities beyond their property boundaries and monitoring those impacts at a micro level is impractical, input controls will have a place in the policy toolkit. The trick is to implement them in the right place and time so that they are effective.

In my view, the catchment is the appropriate scale for an integrated approach. This has been the bedrock of land and water management in New Zealand for almost a century and is one of the things we have managed better than some other countries. Most environmental issues that relate to how we use the land – climate adaptation, water quality, water quantity, biodiversity, pests and weeds – are best managed at a catchment level. Emissions reductions are an exception; it would be best to manage them at a global scale, but due to the political reality of our geopolitical system, they are, in fact, most effectively managed at a national level.[6]

This point does not negate the need for coordination, prioritisation and oversight at a national level. But if central government issues a 'paint-by-numbers' template it will almost certainly lack the information to do this in a way that really makes sense of the environment, and will certainly lack the knowledge of the people who live there. This is particularly important (but by no means uniquely so) for Māori whose assertion of kaitiakitanga is rooted in hapū who whakapapa to particular places with particular valued resources (such as kanakana/lamprey).

Rather than breaking up the environment into different silos, a te ao Māori perspective prefers engagement in an integrated, holistic fashion at a local level. But I suspect most New Zealanders, including individual landowners, feel much the same way. Everyone knows that water, birds, insects and sediment move around.

Taking a catchment-based approach must start by recognising that there is no single 'right' land use for each piece of land. These choices are subjective and depend on how individuals weigh environmental, social, economic and cultural values.[7] The question is, how do we then input the values of local people and engage them in decision making?

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[5] See Macintosh et al. (2018).

[6] See McDowell and Kaye-Blake (2023).

[7] Snelder, Lilburne et al., 2023.

The natural starting point for governance at a catchment level would be regional councils and mana whenua. This raises legitimate questions about the past performance of regional councils in undertaking this role. It would be fair to say that regional councils have struggled to effectively implement central government direction, let alone do so in an integrated way. Without attempting a diagnosis as to why this should be the case, the turnout in regional council elections is mediocre at best and the sector has frequently lacked commanding elected leaders. As is the case at any level of elective democracy, poor turnout can enable the capture of the governance process by vested interests.

There is also a challenge of scale for some regional councils when it comes to attracting skills. Problems of this nature can be alleviated by assistance from the centre, and in some cases this has been provided. But central government can also be the source of other problems.

1. As a result of elections, central government direction can change relatively frequently compared to the time spans that apply to environmental issues and impacts.
2. Central government direction itself tends to be fragmented.
3. Central government direction often comes without the resources and tools required to effectively implement and sustain it (while debt limits constrain council borrowing).[8]

Indeed, the power of central government to direct regional councils may be a driver of low voter turnout. If the public senses that regional councils lack the ability to truly make a difference to their lives, they will be less inclined to engage.

Regardless of the cause, the past performance of regional councils must not prevent catchments or sub-catchments being used as the unit of analysis when it comes to operationalising an integrated approach.[9] In my view, local governance of an integrated approach could be bolstered by investing in the human and financial resources of catchment groups that work in partnership with elected councils. There must be clear lines of responsibility of who does what, something I discuss in more detail in chapter five. Where catchment groups are operating successfully, I would encourage delegating as much decision making to them as possible, but reserve to local authorities the power to intervene to overcome impasses.

Delegation of this nature would require arriving at a practical way of satisfying Māori claims to the management of resources that they value.[10] Māori will of course be landowners and economic players in their own right, but their relationship with the land and the water is wider than that.

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[8] Dickie and Keenan, 2023.

[9] Under current regulation, regional councils are supposed to define freshwater management units in conjunction with community input. In practice, the level of community engagement has varied.

[10] Dickie and Keenan, 2023.

Adequate information

Any enduring solution to this adaptive challenge must start by getting the local community on board with a shared understanding of the scale of the challenge. This requires adequate information, pulling together research outputs, mātauranga Māori and local knowledge to help identify the problems and potential solutions that fit the local context and circumstances. Figure 3.1 illustrates the potential local catchment processes required, as well as the investments needed at different stages of that process.

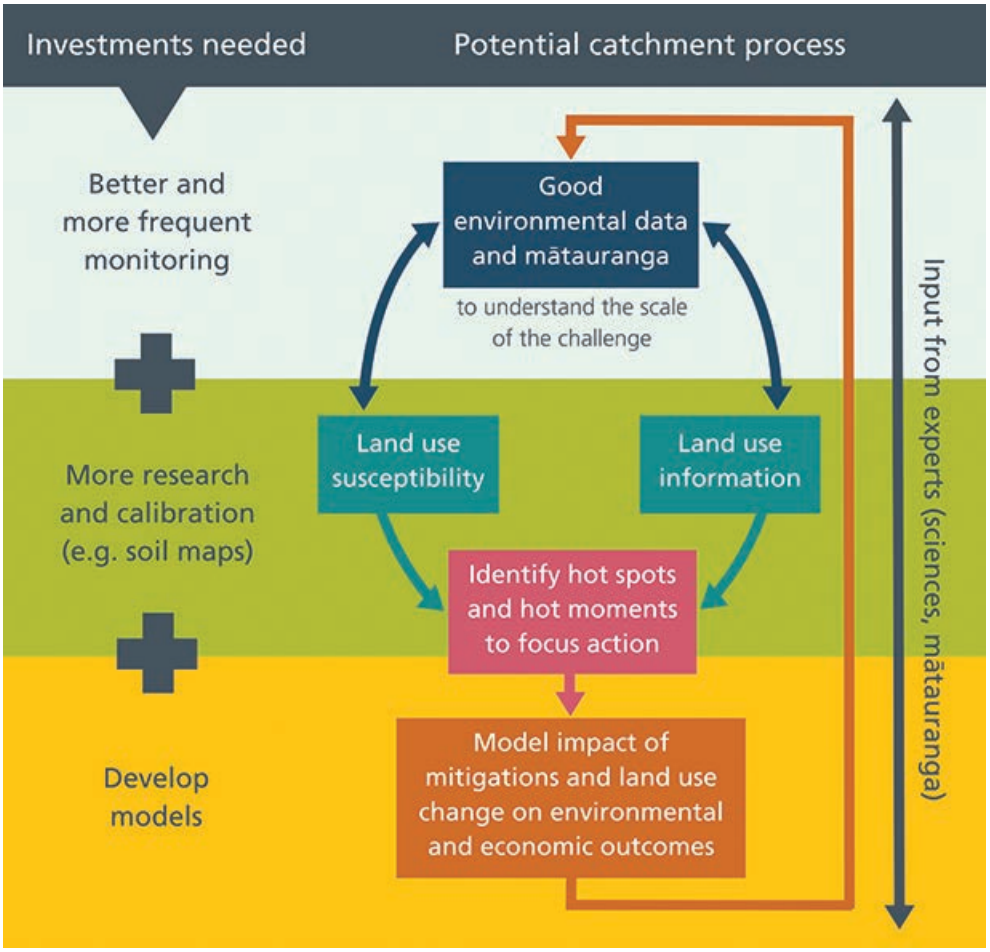

Figure 3.1: Potential catchment processes and investments needed to support them.

Catchment processes need to have clear national guidance with regard to environmental bottom lines and limits as well as other environmental goals. Communities also need guidance on how to prioritise and manage trade-offs across different environmental domains. Even where national guidance is well-established through national policy statements, for example, implementing these can take time. To do so effectively, communities and regional councils need a degree of stability in these expectations, which in turn requires a level of political consensus. I note that the current Government plans to overturn some of the existing policies, particularly with regard to freshwater management, which may in turn cause catchment groups to pause any progress, perhaps for years.

Our ability to assess the scale of the environmental challenge that catchments face relies on the availability of good environmental data, mātauranga Māori and the suitability of models at hand – whether biophysical or conceptual. This information is really needed now for the successful implementation of farm plans. Farmers need this information to truly understand the catchment context and the risks that their farm poses. Good information would make completing farm plans a relatively straightforward exercise for most farmers, and for the rest it would become obvious who needs some targeted support.

I have commented before that the quality of our environmental information is not fit for purpose in New Zealand.[11] The environmental data that are monitored within the environmental reporting framework are at best fragmented – lacking geographical coverage or consistent time series – or at worst not accessible. By not accessible, I mean the data and information are either only available behind a prohibitive paywall, presented in a complex format that cannot be used easily, or have simply been lost. Indeed, the funding of New Zealand's environmental monitoring system is inexcusably low and has been static for many years. This has resulted in cuts and the atrophy of many databases.

In 1992, 26 Nationally Significant Collections and Databases were selected and backed by funding. The list has not been revised in over three decades. While the 26 still benefit from *some* funding today, in real terms they command a much smaller budget. Being on the list at least provides some protection from being forgotten. But there is a plethora of other environmental databases and collections that are not on this list and lack even that status when it comes to arguing for the technical and financial means needed to support an acceptable level of usability. These environmental databases can be classified into five domains:[12]

- **Land environment**, including the S-map Online data and Land Cover Database held by Manaaki Whenua – Landcare Research; the NZ Aerial Imagery Set, NZ Property Titles and NZ River Centrelines held by Land Information New Zealand; and several herbarium and plant repositories.
- **Biodiversity and ecosystem functioning**, including the vast Te Papa entomology collection, the internationally acclaimed iNaturalist database, AgResearch's Margot Forde Forage Germplasm Centre, the Lincoln University Entomology Research Collection and the New Zealand Plant Conservation Network.

[11] PCE, 2022a.

[12] See PCE (2020) for a more comprehensive list of selected databases and collections that contribute to New Zealand's understanding of the natural environment.

- **Freshwater and marine environment**, including Land, Air, Water Aotearoa (LAWA), and the New Zealand Freshwater Fish Database, National River Water Quality Network and Freshwater Biodata Information System held by the National Institute of Water and Atmospheric Research (NIWA).
- **Pollution and waste**, including the Chemical Classification and Information Database and the hazardous substance and new organism application register held by the Environmental Protection Authority.
- **Climate change and variability**, including databases of atmospheric observations (aerosols, carbon dioxide, ozone, water vapour) and the New Zealand rainfall intensity statistics held by NIWA.

It is truly remarkable that a land and resource-based economy like New Zealand lacks a comprehensive database of land use updated in real time. The information exists, but it is not public due to privacy concerns. When it comes to water quality monitoring, without good baseline information on land use and management our existing network cannot tell us if mitigations would be effective at the catchment level. Similarly, data on the health of our soils are insufficient to shed light on trends. These are just three examples of subpar data – all of them seemingly crucial for a biological economy. We are living through a revolution in data collection, interpretation and application technologies. It is possible to collect comprehensive environmental data in time and space in ways that have never previously been imaginable – or even if they were, affordable. Investment in data is as much about infrastructure as building motorways or water treatment plants. It is time governments took a long hard look at their woeful record over the last 30 years.

There is a strong case for this investment to be a public one so that the information can be freely and easily accessible to all land users and form a trusted foundation for any modelling undertaken. Models are an essential tool to help landowners and decision makers understand the potential direction of environmental change under different assumptions. Modelling can usefully combine information on land use susceptibility with information on land use itself,[13] so that environmental hotspots can be identified. There is also a temporal element to this – so-called 'hot moments' or particular times when hotspots can be at an even bigger risk.

But models rely on good data, and without them it is a case of 'garbage in, garbage out'. I have now spent six years making the case for a concerted effort to lift our game on environmental data. Land use change undertaken to improve environmental outcomes or forced on us by natural disasters will be costly. It will be even more costly if we do not have good information to rely on.

[13] In the case study report (PCE, 2024), I experiment with a relatively novel approach known as physiographics (see https://landscapedna.org/). There are other approaches that attempt to do similar things, such as the APSIM model (see https://www.apsim.info/), funded by MfE, or Nature Braid (see https://naturebraid.org/). These tools are immature and still need further development and calibration, and as yet there is no scientific consensus about the best way forward.

Devolved decision making

One issue for devolving decision making is a lack of institutions to devolve it to. I have already discussed the situation of regional councils above.

Where they work well, **catchment groups** can provide a local institution. Unlike research or infrastructure for which central government has long accepted and played a role, the development of local institutions has been left to communities. Catchment groups have been a prominent, if uneven, response to recent central government demands. Their success often depends not only on the quality and skills of the people in them (particularly their leadership) but also on the support and resourcing available, as well as the incentive to collaborate.

The case studies I undertook underlined that the scale of land use change needed to reduce environmental pressures is as much (if not more of) a social challenge as an environmental or economic one. Catchment groups, if empowered with high-quality information, should be a place where mana whenua, landowners, communities and other local stakeholders can confront, face to face, the trade-offs that changing the way we use land lead to.

Our current approach is to hand down generic, high-level requirements, say little about the cost of implementing them, and then leave it to councils and communities to dig out whatever information they can to find a way forward. If sorting out the environmental consequences of land use is really a national priority, then a serious investment into financial and human resources is needed to facilitate the knowledge and community engagement required to make it a reality.

Catchment groups can facilitate many different roles that span information and decision making.[14] They can:

- improve community understanding of the problem
- build a common understanding of and buy-in to the potential solutions (which will often require collective action)
- share good practice across peer groups
- engage with hapū and support them to act as empowered kaitiaki
- help balance cultural, social, environmental and economic impacts to prioritise the most effective actions in the catchment
- inspire action.

[14] Just Transitions Aotearoa Group, 2023.

There are several examples of catchment groups and catchment collectives around the country. In Southland, a network of over 30 farmer-led catchment groups has been established to manage freshwater quality. They cover over 90% of the region. This network is being supported and coordinated by the Thriving Southland initiative (a partnership funded by the Ministry for Primary Industries and private sponsorship, set up with support from the NZ Landcare Trust).[15] Where they exist, catchment groups are already helping farmers prepare their farm plans by building an understanding of the catchment context and potential effective on-farm mitigations. In the future, catchment groups could support integrated farm planning and help show farmers the collective impact of the actions in their farm plans on the health of the local environment.

It is crucial that catchment groups receive high-quality, timely information that is adapted to the specific context they work in. They also need access to expertise to understand and interpret that information to make good decisions. I am interested in ways the Government can support and further build the capacity of these existing groups to explore locally appropriate ways to tackle greenhouse gas emissions, soil erosion, freshwater quality and biodiversity loss, while enhancing resilience.

I am not the first to suggest a greater role for collaborative processes as a solution to common pool resource problems. It has been tried in many guises and is heavily researched.[16] Catchment groups are not a panacea. In cases where resources are overallocated it can be difficult to reach collective agreement on who will lose out. However, when they are successful, they can be a valuable tool. The real question is, what makes them successful?

Nobel Prize-winning economist Elinor Ostrom developed eight design principles to manage common pool resources such as freshwater.[17] These principles resonate with the way Māori exercise kaitiakitanga (as shown in Box 3.2).

[15] See https://www.thrivingsouthland.co.nz/catchment-groups/ for details.

[16] See Just Transitions Aotearoa Group (2023).

[17] Ostrom, 1990.

Box 3.2: Ostrom's design principles on common pool resources and te ao Māori

Elinor Ostrom developed her eight design principles by observing how societies across the globe built up customs – often over generations – to successfully manage common pool resources. The principles include having:

1. clearly defined boundaries of the common pool resources
2. rules that fit local circumstances and conditions
3. participation in the rulemaking of those affected by those rules
4. effective monitoring to create accountability
5. graduated sanctions when community rules are violated
6. low cost and accessible conflict resolution mechanisms
7. higher authorities respect and value the community's rules and self-determination
8. a nested system with multiple tiers to manage large and complex common pool resources.

Given Ostrom's methods, it is no surprise there is resonance in te ao Māori. Kahui and Richards (2014) have provided a detailed account of concepts, definitions and practices applied by Ngāi Tahu, which in many ways echo Ostrom's principles. In te ao Māori, resources are managed by kaitiaki (often chiefs, elders or resource/ritual specialists), who are accountable to and kept in check by their wider hapū and/or iwi to manage resources effectively for the collective benefit. Discussions around resource management are often carried out on the marae.

Resource governance and management is based on kaitiakitanga (the ethic of intergenerational sustainability), which uniquely adapts to local conditions. Spatial and temporal access are regulated by rāhui (a temporary restriction) and owheo (permanent conservation); maintenance of ecosystems is achieved through ohu (communal working bees); and there are rules around the quantity and method of harvesting certain resources. In that sense,

> "conservation was always utilitarian and anthropocentric in nature. Resource controls such as *rahui*, *tapu* and *owheo* … were implemented to ensure the long-term availability of resources. 'It is a pragmatic kind of conservation, though perhaps an ethnocentric one, yet it has worked longer than many modern conservation programs.' (Ehrenfeld, 1989, quoted in Williams, 2004: 230)."[18]

It is worth making a few observations on what might work for New Zealand catchment groups. We are at an advantage in that common pool resource management principles are in close alignment with te ao Māori principles. The next step would be to ensure that equal weight and opportunity is given to applying non-Māori and Māori principles.

An important observation is that collaboration is not easy, and sometimes people need an incentive to take part. There are two important ways to incentivise collaboration: financial resources and devolution of power.

[18] Kahui and Richards, 2014, p.6.

The first way is simple: catchment groups need to be resourced. Currently, funding streams to support catchment groups are patchy and time limited.[19] For catchment groups to be successful, however, they need to be resourced consistently over the medium to long term, particularly the roles of group coordinator and mana whenua.[20] Enquiries suggest that it is possible for one full-time coordinator to manage a few groups at once. The Government could reprioritise money from its many funds (see chapter two) and give priority to groups in environmentally constrained catchments.

A more controversial way to incentivise collaboration is through the devolution of power. A serious devolution of power means not only handing over funding but also decision making. This could include allowing catchment groups to depart from national and regional regulations where the catchment group has developed a credible plan to meet local environmental objectives.

The risk of devolution is that catchment groups sometimes prioritise their own issues rather than the ones identified by regulators.[21] The terms of any devolution would need to be very clear. Beyond that, devolved decision making can be more easily captured by vested interests and biased in favour of the status quo. The charge has been made that regional councils themselves have not been immune to this. How do you stop progress being watered down to reflect the interests of a subset of the community? This is where the first design principle becomes important: the need for clearly defined boundaries, or in other words, defining an appropriate scale at which catchment groups should operate. Crucially, there needs to be a regulatory backstop for those that don't participate to prevent them 'free-riding' on the rest of the community's hard work.

Many people have been experimenting with catchment groups around the country. Where they are working, we should experiment by giving them greater powers and resources with clear links to environmental outcomes. The corollary of that is there would not be complete coverage across the country. This could prove to be an advantage. Localism allows for more experimentation and a greater diversity of approaches and land uses across the country.[22] Some will, quite reasonably, resist a retreat from the idea of a uniform national approach. But on balance, given that there is no one-size-fits-all solution to managing very different places, a diversity of approaches seems to me desirable *provided that* catchment groups are transparently accountable for the outcomes they deliver.

[19] Recent government investments in this area by MfE and MPI are encouraging, including the development of resources to help catchment groups understand their role, such as the Catchment Toolkit (https://www.catchmenttoolkit.co.nz/resources/).

[20] Sinner et al., 2023.

[21] Sinner et al., 2023.

[22] Craven et al., 2019.

Mobilising financial resources to effect change

Access to financial resources is a key barrier for landowners, regional councils and catchment groups trying to effect land use change. Mobilising adequate financial resources to change how we use our land is therefore critical. Below, I discuss some options, from the tried and tested approach of grants and loans funded by taxpayers, through to more innovative market mechanisms.

Publicly funded grants and loans

Historically, central and local government have used grants and loans (funded by taxpayers and ratepayers) to encourage changes to how we use the land. Grants are particularly important for entities without income sources, such as some Māori landowners and catchment groups. The advantage of grants and loans is that specific criteria can be attached to ensure public money is spent appropriately. The downsides include increased administration for all involved (especially given the proliferation of schemes) and uncertainty around future funding.

Central and regional government could design an integrated grant and loan scheme with broad criteria customisable to local circumstances. The need for local customisation suggests that regional councils, mana whenua and catchment groups could ideally lead the grant-making process. New funding may not be needed; many existing schemes could be integrated into this approach.

An integrated grant and loan system should target the most environmentally constrained catchments, particularly the hotspots within them. They could fund catchment groups and help meet the costs of implementing nature-based solutions that deliver the greatest improvement in local ecosystem services. Nature-based solutions might include restoring wetlands or afforestation to improve biodiversity, sequester carbon, reduce erosion and regulate water flows.

Reducing erosion and regulating water flow will be especially important in areas that are increasingly susceptible to extreme weather events. Retiring peat lands is also a possibility, although the high value of this land suggests that it might be ideal to start in areas most at risk from climate change (sea level rise and extreme events). How the cost of implementation is shared depends on what we want from our catchments, and how much of that we expect landowners and communities to do themselves. Targeting hotspots means that some landowners will need to do disproportionately more than others, and grants are a way to make that action more equitable.

Where new land uses are trialled and likely to be economic, demonstration grants (for first movers) and underwritten loans can be valuable tools to encourage land use change. Loans can also be helpful where investments in infrastructure are needed to support new land uses (e.g. processing capacity to support new land uses). Loans were used heavily in the transition following the removal of agricultural subsidies in the 1980s. Where land uses are not economic or land is under Te Ture Whenua Act, grants may be necessary. For uneconomic land, land buybacks might also need to be considered.

One potentially controversial form of infrastructure to facilitate land use change is water storage. In the past, water storage has been touted as having benefits for the environment that have not always materialised in practice as land use has intensified (usually to dairying) to pay for the water storage.[23] I am not opposed to water storage infrastructure in principle, but there need to be strong environmental limits in place within a catchment before investment in water infrastructure occurs. Ideally, water storage should be used to provide security of supply to high-value uses, rather than to increase water use *per se*. As discussed above, we lack the tools to enforce such limits effectively at the farm scale, and therefore great caution is needed when considering the use of public money for water storage schemes.

Uncertainty around future funding is more challenging to resolve. Changing how we use the land is a challenge with long time frames, and catchment groups tend to struggle finding commensurately long-term funding. Grants and loans can be accompanied by contracts promising future funding if certain conditions are met. However, any solution that is dependent on taxpayer or ratepayer funding will always be vulnerable to reprioritisation. Market-based mechanisms could – if successfully introduced – provide more stable funding streams.

Market-based mechanisms

Where outcomes can be accurately measured and attributed, market-based mechanisms can be used to place a price on resource uses that impose environmental costs. These mechanisms effectively include the cost of environmental damage and/or the value of environmental improvement in a farmer's bottom line. Another benefit of these tools is that prices do not mandate specific actions. Instead, they provide incentives to change behaviour. People can choose *how* they change their land management or use – or can even decide not to change behaviour and pay the price instead.

In some cases, market mechanisms are being put in place by private companies to encourage environmental best practice. These tend to reward good performers with a premium and/or exclude poor performers. However, the robustness of the incentive ultimately depends on consumer demand. In my view, this makes private sector schemes vulnerable to trends, and as such they are no substitute for government-mandated schemes.

Compared with other developed countries, the use of environmental market-based mechanisms in New Zealand is relatively low.[24] While not their intended purpose, government-led market mechanisms can also raise revenue that can be used to either offset other taxes or meet other spending priorities.

The chief concern with market-based mechanisms is that if incorrectly specified, their outcomes can lead to gaming or unintended consequences. The best current example of this is the NZ ETS. My two catchment case studies indicated that under current policy settings the NZ ETS is the main driver of land use change, mostly from sheep and beef to pine production forestry. This is confirmed by the most recent Survey of Rural Decision Makers, which found that the main driver of land use change currently is carbon.[25] That was not the intended purpose of the NZ ETS. It is, rather, its foreseeable but unintended consequence. The role of the NZ ETS as a barrier to effective land use change is discussed in the next chapter.

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[23] See Thomas et al. (2020).

[24] See OECD (2024).

[25] See Manaaki Whenua – Landcare Research (2023).

Very recently there has been discussion about biodiversity credits as a potential market-based mechanism.[26] However, biodiversity is so localised that it would make trading across different species and jurisdictions difficult. It is also not yet clear what the scale of private sector demand for these credits would be. If biodiversity credits are an attempt to bid for public funding, then we should take an integrated approach that targets the most environmentally constrained catchments and hotspots within them, as discussed previously.

Pricing water

A price could be placed on the commercial use of water – either for consumptive (e.g. irrigation), non-consumptive (e.g. most hydroelectricity) or absorptive capacity (e.g. nitrogen leaching) purposes. To implement any of these, rights to use freshwater need to be clarified and actual use measured.

Any durable set of rights around the use of freshwater will require resolving Māori rights and interests (discussed below). Water use is measurable now that metering is required as part of resource consents. Conversely, nitrogen leaching has proved very difficult to measure accurately at a property level, with landowners instead relying on results modelled using Overseer, which with all its limitations creates a risk of gaming. As a result, nitrogen leaching is much more difficult to price accurately.

A price on water would act as a resource rental, recognising both the damage to the environment of taking water and its value as an input into a commercial undertaking (residential use could be exempt). This would provide an incentive to ensure that water is allocated to its highest value use. A charge could also provide revenue to safeguard the future of that resource.[27] In terms of Te Mana o te Wai, this is making sure that we look after the river first. Combined, these arguments for a resource rental would help achieve the goal of this paper – ensuring that as a nation, we maximise the social, cultural and economic benefit of our natural resources while making sure we look after them for future generations.

A resource rental would likely be a small charge per unit of water used, ideally adjusted for the scarcity of water in the particular catchment. This would have the greatest relative impact on the largest users of freshwater in New Zealand, particularly those using water for irrigation and hydroelectricity generation. A 2014 study by the New Zealand Institute of Economic Research (NZIER) and AgFirst estimated that irrigation increased the productive capacity of landowners (particularly in Canterbury) to the value of $2.17 billion per year.[28] Currently these businesses can use this valuable natural resource for free, so this value is capitalised in land prices.

Although most hydroelectricity generators are returning the water to the river immediately after it is used, dams prevent the migration of some species, significantly alter flow and temperature and contribute to water loss through increased evaporation. This impact on the mauri of our awa needs to be acknowledged appropriately. While non-consumptive water users could pay a lower per unit price than consumptive users, they should in fairness pay something.[29]

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[26] PCE, 2023b.

[27] Tax Working Group, 2019.

[28] Corong et al., 2014.

[29] In Scandinavia innovative policies have been enacted to manage hydropower. In Norway, resource rent taxes have been applied to ensure a share of the return on hydropower accrues to society (Ministry of Finance, 2022). In Sweden, a new national relicensing plan means many small hydropower plants are opting to be decommissioned, with the funding for this, and other environmental measures, coming from the largest hydropower companies (Borg, 2020).

The revenue from any such a rental could be channelled into investing in activities that reverse the decline in freshwater quality that we have seen in recent decades. The revenue could be retained within the catchment or region where it is collected. This would, however, disproportionately benefit Canterbury. Alternatively, it could be used to buy back water use rights in overallocated catchments and the remainder channelled into other restorative activities through grants and loans as per above.

Pricing biogenic methane

Currently there appears to be political consensus between the two largest parties in Parliament that a price should be levied on biogenic methane emissions. The main area of disagreement is the timing of implementation.

Again, the revenue from a price on biogenic methane could be retained within the catchment or region where it is collected. In this case there is likely to be a better match between revenue and the catchments facing the greatest environmental challenges.

Source: Angela Mulligan, Unsplash

Figure 3.2: Revenue from a price on biogenic methane could be retained within the catchment or region where it is collected to help fund environmental mitigation measures and land use change.

For biogenic methane, a cap-and-trade scheme would in my view be preferable to a tax or levy. While a tax or levy would provide greater price certainty and simplicity, there are two main advantages to a cap-and-trade scheme:

- Firstly, a cap-and-trade scheme is more appropriate for methane than long-lived gases such as carbon dioxide because emissions do not need to be reduced to zero. To reduce carbon dioxide emissions to zero under the NZ ETS will (in the absence of complementary measures) eventually require an exponentially high carbon price. For short-lived gases like methane, the goal is to reduce emissions to an acceptable flow rather than eliminate them altogether. Hence the importance of ensuring that the price incentivises the most efficient producers.
- Secondly, using rotational pine production forestry (or potentially other species) to offset some of the warming from biogenic methane is a more justifiable strategy than using it to offset fossil carbon dioxide since it does not involve the permanent loss of the land's option value. I have elaborated my reasoning for this conclusion in *How much forestry would be needed to offset warming from agricultural methane?*[30]

A new cap-and-trade scheme for biogenic methane should be investigated that allows for some forestry offsets.[31] For this to work, however, production forestry would need to be removed from the NZ ETS (see chapter four).

There seems to be little doubt that putting a price on biogenic methane would – all things being equal – reduce emissions. The question is, how would this happen and what would be the likely impact on other environmental outcomes?

A price on methane as proposed would enable farmers to choose between a menu of options, including on-farm mitigation, using afforestation as an offset, simply paying the price or destocking. Exactly how landowners would react depends on the costs and benefits of different options. Where techniques and technologies to reduce on-farm emissions exist, a price on agricultural emissions would incentivise their uptake. Even if no new technological options to reduce emissions emerge, a well-designed price would favour more efficient producers of meat and milk, allowing them to expand at the expense of less efficient producers. Improving efficiency has been shown to improve profitability and environmental outcomes at the same time and should be encouraged.[32]

More profitable landowners (e.g. dairy operating on more productive land) are likely to choose from the first three options where they exist. If they do not have sufficient unproductive land to afforest to offset their emissions, they may choose to purchase offsetting from other landowners. Marginally profitable farmers faced with a price may choose to exit livestock farming entirely, and productive farmers paying for land to be afforested could provide them with an exit strategy. As a result, a cap-and-trade scheme for methane would likely continue the conversion of sheep and beef farms to forestry.[33] This would certainly offset the warming effect of methane emissions, but it is the impact on other environmental and social outcomes that would continue to be the subject of considerable debate.

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[30] PCE, 2022b.

[31] See Bognar et al. (2023).

[32] BERG, 2018.

[33] See also PCE (2024).

A combined intensity-adjusted land tax and natural capital enhancement subsidy

If the aim is to reverse the loss of biodiversity and degradation of water quality, and we accept that ongoing payments are needed in some form to achieve that, a logical funding source would be an intensity-adjusted land tax. That is, a tax based on a percentage of the value of the land, but adjusted for the degree of environmental impact that is being imposed. Land covered with roads, concrete or buildings, for example, would be subject to the full tax. Farmed land or buildings with green roofs, which still support biodiversity in some form, would be partially taxed. Land in a natural or restored state would receive a subsidy (in effect a recognition of the ecological services being provided).

A tax and subsidy system could be designed to be revenue neutral overall. Effectively, an intensity-adjusted land tax absorbs the concept of biodiversity credits and takes funding it to its logical conclusion. Such a tax and subsidy system would sensibly be administered by government. It could also be used to offset some environmentally based local government charges.

Due to the revenue-neutral nature of this tax, it would not be a direct source of revenue for catchment groups, unless they are landowners. However, farmers, mana whenua, and potentially also local authorities would receive payments for land they own that is maintained in or returned to its natural state.

This idea was initially pitched by the Tax Working Group in 2019 as a 'natural capital enhancement tax':

> "The tax aims to recognise that natural capital produces valuable ecosystem services. It provides incentives for the conservation, restoration and regeneration of high-value natural capital, going beyond more narrowly targeted negative externality taxes. Remote sensing technologies, combined with mapping and modelling tools, could potentially be used to assess both the level and change in the ecological value of a specific area of land or coastal zone."[34]

As always, a key challenge with such a system is having sufficiently granular, high-quality data to implement such a tax and subsidy system. Such data are increasingly feasible to collect with remote sensing technologies and artificial intelligence.

[34] Tax Working Group, 2019, p.54.

Another implementation challenge would be working through the relative tax rates between different land uses based on the best science available and ensuring that Māori-owned land is not disadvantaged. However, for land use, there have been numerous indicators that combine agricultural intensity into a single measure and relate this to environmental performance like water quality.[35] The relative contribution of different land uses would no doubt attract controversy and need to be grounded in good science.

This idea is speculative and may be dismissed by some as unrealistic. However, it is difficult to think of another tool that could provide the resourcing needed to achieve our environmental goals, and do so in a fair and transparent way. A tax and subsidy system would start low and could be progressively dialled up until the country's environmental goals are reached.

This idea does raise an important point. Landowners will look to be compensated by the taxpayer for environmental improvements. This, however, undermines the 'polluter pays' principle, especially in cases where landowners have contributed to – and benefitted from – environmental damage without paying for it. How much should they contribute to solve the problem? Or, looking at it another way, how much of their effort should they contribute for free? To be good stewards of the land, what baseline level of environmental management should simply be expected? These are all important questions to ask when considering an integrated approach to land use.

[35] Giri and Qiu, 2016.

3 What would be needed to do a better job?

4

Schizaea dichotoma

Some barriers that stand in the way of land use change

Doing a better job of caring for land and water is not just about adopting new practices or changing land uses. It may also be about removing barriers. Some of these barriers are highly local, others are structural.[1] While there may be quite strong incentives to change, landowners can face a complex array of barriers to consider when making their land use decisions. This creates uncertainty when making both the small and large investment decisions needed to change direction.

In 2017, the Ministry for Primary Industries (MPI) commissioned a useful literature review that summarised the drivers and barriers in play when land use change is under consideration.[2] It covered biophysical, economic, technological, societal, regulatory and individual factors. The review acknowledged that many of these factors interact in complex ways that will vary according to the specific case. The following discussion highlights some barriers that were apparent in conversations with both landowners and researchers undertaken in the course of the two case studies. It also draws on MPI's work and other research.

[1] For example, see Biden (2023).

[2] Journeaux et al., 2017.

Commercial imperatives

Farmers wryly note that 'you cannot be green if you're in the red'. Profitability is essential if landowners are going to invest in land use change. The capacity to borrow depends on profits or at least the promise of future profits.[3] In what is essentially a sector dominated by small businesses, there is often a strong culture of family ownership, and injections of equity funding are relatively rare.

Land use change often involves large capital outlays, and it can take years before the changes start to generate returns. The capital outlay is not restricted to on-farm changes. Before any land use change can happen, landowners need to invest in research and advice to understand their land and potential alternative uses. It can be challenging for landowners to receive land use agnostic advice. This is because not many farm advisors are trained to provide advice across different land uses while industry bodies must focus on their respective commodities under the Commodity Levies Act 1990. Advice on land use change is also complex. While land use change *per se* is relatively simple, the knock-on effects of bringing new products to the market require the development of new customers, new processing infrastructure and new distribution channels.

These challenges are daunting for any small business with limited resources operating in a global market. Farmers are no exception. New Zealand has a small domestic market and is a long way from international markets. In its work on frontier firms, the Productivity Commission catalogued the challenges facing small businesses trying to export in such circumstances.[4] These uncertainties are much smaller in the more established industries such as dairy, meat, apples, kiwifruit and pine production forestry because producers have been able to organise themselves collectively (in varying degrees) to research, process and market their commodities.

The reduced uncertainty that collective action provides naturally biases landowners towards established industries. This is not always positive for the environment. The Dairy Industry Restructuring Act 2001, which created Fonterra, was justified on the basis of creating a "national champion" that could diversify into high-value consumer products.[5] This strategy has failed to meet expectations and Fonterra has returned to a more traditional strategy of driving improved commodity returns for the benefit of suppliers. Unsurprisingly, this approach incentivised conversions to dairying and with them an intensification of land use up until around 2016.[6] As we know, intensive dairy farming has contributed to poorer environmental outcomes in some parts of the country.

Given these different factors to consider, and the complex and fragmented policy landscape, it is understandable that landowners are risk averse and biased towards the status quo in their decision making. This has huge implications for the speed of land use change for two reasons.

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[3] See Environment Southland (2022).

[4] NZPC, 2021.

[5] NZPC, 2020.

[6] NZPC, 2020.

Firstly, if investments have been made in the recent past, landowners will want to recoup the returns on their investment before making further changes. Secondly, as with any small business owner, a significant change to the business will often literally mean betting the house. For most farmers, the main source of capital for investment will be bank loans. Banks in New Zealand are risk-averse lenders that find home lending an easier and more profitable activity than farm lending. Landowners are naturally (and quite rightly) cautious about exposing themselves to commercial risk. Based on this analysis we might expect some of our larger corporate, iwi or publicly owned farming operations (such as Pāmu/Landcorp) to lead the charge on land use change in environmentally constrained catchments as they will be better placed to spread the risk of experimentation across their operations.

Unsurprisingly, the relative profitability of dairying makes a transition to lower-intensity practices more commercially achievable than is possible for sheep and beef, which has seen its average profitability decline to the point of being marginal. Where land is suitable for conversion to a more profitable use (for example, from sheep and beef farming to dairying or forestry), the sale and transfer of the land can draw a neat line under yesterday's unsustainable uses, as the purchaser starts with full knowledge of the need to meet higher standards. But where this convenient exit route is not available, the resources available for sustained environmental clean-up are meagre.

This highlights the point that as a country we have few tools for improving the environment where environmental goals impose a cost that landowners are unable to bear. The implementation of environmental policies is often pushed onto regional councils, which are left to confront landowners, who in some cases – but not all – lack the resources to deliver what is expected of them. In cases where landowners do lack resources, their precarious position might be further compromised by increased pressures from global food companies and banks that will increasingly require them to measure and reduce emissions as well as make biodiversity improvements. Regional councils have raised this issue with the Ministry for the Environment. For the current set of freshwater plans (for which the current Government has pushed back the implementation deadline) regional councils are focusing on what they can achieve within current tools. In the absence of profitable alternative land uses, the only large-scale example we have of a successful transition to less environmentally damaging land uses is Lake Taupō – and that was a mixture of de-intensifying land uses and preventing further intensification. Iwi buy-in and $80 million compensation from central and local government was crucial to the success of this initiative.

The New Zealand Emissions Trading Scheme

The NZ ETS is currently the main commercial driver of land use change. While afforestation is certainly needed in parts of Aotearoa and the NZ ETS provides a source of revenue for this, the scale of this change has the potential to create negative externalities and foreseeable unintended consequences (while reducing other pressures). In my view, using such a blunt tool as the main driver of land use change is becoming a barrier to the outcomes we are seeking.

My concerns with the use of forestry as an offset for fossil fuel emissions began with the work on *Farms, forests and fossil fuels*.[7] Carbon emissions stay in the atmosphere indefinitely. How can we ensure that the carbon sequestered in a forest stays locked up for similar time frames in the face of risks of fire, diseases and policy change? These risks are likely to grow as the climate itself changes and are higher for permanent forests, which will need management long after the income flow from carbon sequestration has ceased.

The environmental impacts of new forests will vary depending on local conditions, the type of forest and the management regime. The key point is that the NZ ETS drives land use decisions based on tree species that absorb carbon quickly (usually pine). This will not necessarily lead to forest management decisions that are optimal across all environmental outcomes (let alone social and economic ones).

More recently, questions have arisen about the durability of the NZ ETS given its current settings – particularly the use of forestry as a source of unlimited offsets. These issues are well covered by He Pou a Rangi Climate Change Commission's latest advice.[8]

Additionally, there have been concerns about the loss of productive land from widespread afforestation. Theoretically, this is unlikely to become a problem soon as Te Uru Rākau has estimated that there are close to 2.7 million hectares of low-productivity, privately owned pastureland suitable for afforestation.[9] However, it is difficult to know if current and projected afforestation is restricted to low-productivity pastureland. The Ministry for the Environment has estimated that at current carbon prices it is economic to convert more productive land in addition to that included in the estimates done by Te Uru Rākau. The type of forest can also make a difference – permanent carbon forestry can be on difficult-to-access marginal land, but production forestry needs to be accessible for cost-effective harvesting and transportation to market.

The feasibility and impacts of establishing different types of forests in different locations is a complex question I am addressing in a forthcoming review. The costs, revenues, risks and benefits associated with any newly established forests will depend on a number of things, including the type of forest, where it is located, and how it is managed.

The current unrestricted use of forestry as an offset is removing different land use options from future generations. Long-term predictions are purely speculative, but it is easy to foresee scenarios where this might become a problem. In the second half of this century there is a risk of running out of low-productivity pastureland for afforestation. If we do not reduce gross emissions, we will need to keep planting trees on more grassland in perpetuity. This risk is more likely to eventuate if we continue to allow unlimited forestry offsets in the NZ ETS as it depresses the carbon price and reduces action on gross emissions. The country also needs to consider the potential need to go carbon negative to restrict warming.

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[7] PCE, 2019a.

[8] He Pou a Rangi Climate Change Commission, 2023.

[9] Te Uru Rākau New Zealand Forest Service, Ministry for Primary Industries, pers. comm., November 2023. Note that this model was run in 2020, so there may have been changes since then.

A more immediately pressing issue than the loss of productive land is the social and economic impact of converting sheep and beef land to pine production or permanent carbon forestry. This is a hotly debated issue and both industries have published research to support their arguments.[10] The answer ultimately lies in the eye of the beholder; on a judgement of 'who matters', both on spatial and socio-economic (landowners versus workers) scales. What is clear, is that permanent carbon forestry reduces employment overall.

It is worth noting that in deciding the rating differentials for ratepayers, Wairoa District Council on the East Coast has determined that forestry activities are of minimal benefit to the Wairoa community and that forestry has a negative impact on employment in the district. The High Court did not dispute the council's reliance on the 'disbenefits' of forestry to community wellbeing when considering its rating decision.[11] Similar concerns were noted by local communities in the course of our case studies.

Pine production and permanent forestry are legitimate land uses and, as long as they are properly regulated, they should be free to compete with other land uses. But afforestation should not be incentivised by treating it as a cheap way to offset fossil fuel emissions. In my view, the NZ ETS should be retained as a tool for reducing gross emissions, but the right to use forestry as an offset should be progressively phased down over time.[12]

Removing forestry from the NZ ETS should allow the Government to auction more credits at a higher price. The augmented revenue could be applied to incentivise changing how we use the land (as per the 'Publicly funded grants and loans' section above). This should include paying for nature-based solutions that sequester carbon and generate other ecosystem services such as afforestation or restoring wetlands on private land and whenua Māori.

Using revenue from the NZ ETS to fund nature-based solutions on our land may seem oblique, but in many ways, it is more compelling. Firstly, New Zealand's greatest contribution to warming has been land use change through deforestation. This would be an opportunity to recapture some of the enormous carbon stock that was emitted to the atmosphere during the 'breaking in' of much of Aotearoa, together with the collateral environmental damage inflicted on biodiversity. It makes sense for modern day fossil fuel users to pay to repair the widespread damage that occurred during the formative stages of this contemporary capitalist economy. Secondly, these actions would (if well targeted) also prove to be valuable investments as the climate changes. Essentially, such a fund could be billed as funding nature-based solutions for climate adaptation.

[10] See, for example, Harnett (2019) and Harrison and Bruce (2019).

[11] *New Zealand Forest Owners Association Incorporated v Wairoa District Council* [2023] NZCA 398.

[12] I am not alone on this point; see, for example, Cullenward (2023) for a similar argument.

Source: Geoff McKay, Flickr

Figure 4.1: Native trees and pine production forestry are visible from Fern Walk in Tōtara Reserve Regional Park, Pohangina Valley.

Individual factors

It is often difficult for others to understand why people make the decisions they make. However, factors relating to the individual could be among the most important barriers to land use change, at least in the short to medium term. In the longer term – for example, when a property comes up for sale – it is more likely that a new owner will be willing to take a fresh look at land use to get the most value from their investment.

Research indicates that 'lifestyle' factors are a major barrier to land use change. Several studies show that many farmers accept below-average returns on their investment even when capital gains are included.[13] While there may be a number of reasons for this, including the farm being both the business and the home, the lifestyle benefits of farming are likely to be one of them.[14] A survey of rural decision makers found that farmers who had not changed land use, intensified it or increased the size of their farm gave reasons like 'lifestyle' (53.6%) and 'the imminent anticipation of retirement' (12.6%). Several other responses clearly also related to lifestyle, including 'age', 'already retired' and 'happy as I am'.[15]

[13] DairyNZ, 2022; Greig et al., 2018.

[14] Greig et al., 2018.

[15] Journeaux et al., 2017, p.15.

Cultural factors will also influence decisions on land use. A case study in the Waiapu catchment in Gisborne focused on the economic and cultural implications of changing land use under different climate change scenarios for Māori landowners.[16] The land in question had relatively large areas of land in Māori ownership and is prone to extreme erosion. The scenarios (all focused on afforestation) were also assessed using a kaupapa Māori tool.

Kaitiakitanga (Māori sustainable resource management), manaakitanga (the reciprocity of actions to the environment and people), and whakatipu rawa (the need to retain the resource and asset base for future generations) were the principles used in the tool alongside the economic modelling. The study found that these values, incorporating a long-term intergenerational view, were more important than economic ones when it comes to making decisions on changing land use.

This underlines the point that the scale of land use change needed to achieve our environmental goals is as much a social and cultural challenge as an economic one. Economic incentives will no doubt make a difference over the medium to long run, but in the short term, social considerations are also likely to impact on decision making. Understanding these social and psychological considerations is the motivation behind the *Moving the Middle* research programme being led by Manaaki Whenua – Landcare Research.[17] It is investigating the pressures landowners face and the types of interventions that can reduce these pressures to empower them to make land use and land management changes to achieve environmental goals.

Regulatory rigidity

Many of the sources of regulatory rigidity are an attempt to manage specific environmental problems. They tend to put up barriers to land use change on the assumption that it might negatively impact on the environment, but in practice these barriers might also prevent positive changes.

As noted above, our tendency as a nation is to use property rights as the unit of regulation, despite that not always being appropriate. Ensuring that land use is well matched to the capability of the land beneath it will always be difficult when taking this approach. Allocating new rights tied to property is an extension of this approach. Ultimately, there is no fair way to allocate resource rights, but ideally they should be tradable so that available resources are used for their highest possible value consistent with maintaining environmental quality.[18] If resources are not tradable, that can cut off the possibility of land use changes that might be better from both a holistic environmental perspective and an economic perspective.

We have already noted above that obligations under the NZ ETS reduce options for land use change. However, at least the carbon obligation is tradable.

[16] Awatere et al., 2018.

[17] Greenhalgh and Morgan, 2021.

[18] See McDowell et al. (2018).

Resource management

There has been no specific research into the extent to which the resource management legislative framework impedes changes to land uses with lower environmental impacts. However, there is research into regulatory barriers that prevent the uptake of techniques to reduce the environmental impacts of existing land uses.[19] An example of such a barrier is where mitigation requires earthworks or the alteration of a water body, which often requires resource consent.

While many regional councils have categorised mitigation techniques as permitted activities, this varies across regions and they are often accompanied by a long list of conditions that are difficult to meet. Many regional councils overcome this barrier by offering grant funding to support these activities. Research into best practice for the implementation of mitigation techniques that take a multidisciplinary perspective might help councils refine conditions to improve both the uptake of mitigations and the consistency in their quality.[20]

The same regulatory barriers may apply to land use changes with lower environmental impacts (particularly those involving subdivision of land). Embarking on novel land uses may be considered too difficult if the burden falls on the landowners to demonstrate that the environmental impacts are lower, and the threshold for proving this is set too high or is too costly. One particularly controversial example of a land use change that *could* have lower overall environmental impacts, but faces large regulatory barriers, is conversion to lifestyle blocks.

Territorial authority restrictions often prevent people from being able to subdivide and sell land for lifestyle blocks or other so-called non-productive uses. The rules were originally driven by farmers concerned about lifestyle blocks eating up agricultural land but have in recent times been adopted by urbanists and planners opposing low-density development (Waikato Regional Council's Future Proof Strategy is a good example). Yet subdivision can free up capital to enable landowners to upgrade environmental practices or change land uses.

The previously cited MPI document summarising barriers to land use change has this to say:

> "Broadly, Territorial Authorities have a relatively permissive attitude to land use (in the sense that land use is permitted relative to various standards; it does not infer a 'do as you like' approach), apart from rural subdivision. This is often tightly controlled, in an endeavour to maintain land parcels as 'economic units' and/or prevent the loss of high quality soils. Often, though, subdivision is a prerequisite for land use change, particularly for horticultural development, and there are strong economic drivers for this. Similarly, subdivision of rural land for urban development is driven by extremely high economic (and often political) factors."[21]

Some district councils allow farmers to subdivide and sell lifestyle blocks for them to free up capital to invest in environmental improvements (such as restoring native bush, wetlands or riparian areas).[22] In practice there are often many technicalities that make this process complex. One drawback of this approach is that subdivision often happens on the best quality land because it is the flattest. The concern is that fragmentation of farmland into lifestyle blocks can leave the remaining pockets of land unviable for farming, leading to more lifestyle blocks. In some areas the development right can be sold and transferred.

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[19] Milne and Luttrell, 2020.

[20] Milne and Luttrell, 2020.

[21] Journeaux et al., 2017, p.6.

[22] See, for example, KDC (no date).

It is worth noting that lifestyle blocks are used as a conservation tool by Trust for Nature in Australia.[23] They have a revolving fund that allows them to purchase properties, alter land use to ensure it is more sustainable, apply covenants where appropriate and resell the property. Often close to urban areas, they will convert the land to lifestyle blocks and sell them with the assurance that the new owners will act as caretakers of these important environmental areas.

Water rights tied to land parcels

Access to the right to use freshwater is essential to finding profitable land use options with a lower impact on the environment. Unfortunately, the rights to use water are usually tied to land parcels and difficult to trade.

Recent national policy statements deal with the thorny concept of freshwater allocation. Te Mana o te Wai imposes a hierarchy of obligations where the first priority emphasises the health and wellbeing of water bodies and freshwater ecosystems (e.g. ensuring minimum flows), followed by human health needs (such as drinking water), and finally water for social, cultural and commercial needs.[24] The discussion in this section only applies to the allocation of freshwater for commercial purposes.

Unfortunately, these principles of water allocation have only recently applied. As a result, there are three major environmental problems stemming from historical water allocation that took place in the absence of national direction:

- Firstly, consents to use freshwater (either from ground or surface water) have been dealt with on a first-come, first-served basis. This means that the water has not necessarily been allocated to the highest value use.
- Secondly, the consent to use water is linked to the land title. As a result, the right to use water is linked to land ownership and is therefore capitalised in the land value,[25] although a recent court decision restricts the ability to use consented water for different purposes.[26] While the Resource Management Act 1991 allows for a transfer of water rights between two landowners in a catchment, the process is painstaking and rarely used.
- Finally, some catchments have been overallocated. This means that when there is a dry spell the flow of water can fall below the level needed to sustain the environment. Clearly, this is not aligned with the goals of the national policy statement as set out above. However, it makes any attempt to transition from the status quo challenging. In these catchments the first two challenges are compounded.

It is unclear how these challenges around water allocation will be resolved. Following the repeal of the Natural and Built Environment Act 2023 and the Spatial Planning Act 2023, the Resource Management Act reform signalled by the new Government will need to comprehensively address the environmental challenges of water allocation. This is a major issue for reform, further complicated by commitments to 'rebalance' Te Mana o te Wai by replacing the National Policy Statement for Freshwater Management and the National Environmental Standards for Freshwater.[27]

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[23] Trust for Nature, 2017. It is worth noting once again that this would be more complex for some Māori land.

[24] MfE and MPI, 2020a.

[25] Garner, 2020; Grimes and Aitken, 2008.

[26] *Cloud Ocean Water Limited v Aotearoa Water Action Incorporated* [2023] NZSC 153.

[27] New Zealand National Party and ACT New Zealand, 2023; New Zealand National Party and New Zealand First, 2023.

Similar issues occur where councils have allocated rights to pollute freshwater. As noted in chapter three, this is very difficult to do accurately. To reduce nitrogen leaching, Environment Canterbury has allocated the right to leach nitrogen based on (modelled) historical levels.[28,29] These rights have been allocated to properties and are not tradable, thereby further impeding progress and allocating a valuable right to pollute to users who may not be the most efficient resource users.

There is never an ideal way to allocate the right to use or pollute water. Given that it can have a large impact on land values, it is first and foremost an issue of fairness. This is a matter of subjective judgement that lies in the realm of politics. The most important objective factor to consider is ensuring that the process of allocation does not create any perverse incentives (for example, inadvertently encouraging pollution by rewarding those who pollute more in a given period, i.e. grandparenting) or encourage hoarding.

From an economic perspective, the more important factor is to make sure that however rights are allocated, they are in some way tradable. The theory is much the same as for other forms of rights to access or use resources: that by making them tradable they are able to find their highest value use. This becomes even more important in a situation where we are trying to minimise the economic impact of applying environmental constraints.

Setting out a rational way to manage freshwater is relatively straightforward. The question is how to undertake a reform that can provide certainty to existing and future water users so they have the confidence to invest and at the same time resolve Māori rights and interests over freshwater. The Land and Water Forum's third report was optimistic that the issue could be resolved to mutual advantage:[30]

> "For a system which articulates general rights and interests to be stable and durable, however, iwi rights and interests also need to be resolved. We can see significant win-wins in this process, including the development of under-utilised land and resources, and the ability of iwi to partner with others [in] the growing of the water economy – including through the development of infrastructure."

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[28] MfE, 2023a.

[29] The region-wide nitrogen allocation framework essentially grandparents historical nitrogen losses, adjusted to reflect Good Management Practices. In catchments where limit-setting processes have been completed, there are further requirements to reduce nitrogen losses. These are usually expressed as a percentage reduction below historical (i.e. grandparented) rates. (Environment Canterbury, pers. comm., March 2024).

[30] LAWF, 2012, p.8.

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Sticherus tener

A way forward

The way we use the land has changed over time and will continue to do so. The environmental impacts of land use are just one driver of change, albeit a prominent one in recent years. Looking forward, difficult trade-offs will need to be made in some parts of the country between environmental, cultural, economic and social objectives. The key message of this report is that central and local government need to be upfront and transparent about these trade-offs and work with communities and mana whenua to agree and manage those trade-offs. Some tough conversations lie ahead, and the process will not be easy. But the quicker we press on with the job, the better.

Contaminants to water, biogenic greenhouse gases, and biodiversity loss (probably in that order) are the biggest pressures land-based industries currently place on the environment. They also pose risks to continued market access and consumer acceptance as international awareness of the true cost of food production grows. Even if we want to avoid addressing the environmental pressures that current uses place on the land, an increasingly disrupted climate will leave some landowners stranded.

The modelling we undertook for the Wairoa and Mataura case studies suggested that current policies could encourage the expansion of two dominant monocultures: dairying and pine production forestry.[1] It showed how economically precarious some current land uses are, suggesting that the status quo is neither environmentally nor economically viable beyond the short term.

My conclusions are based on the twin premises that governments do recognise (1) the importance of improving the environmental footprint of our land-based industries and (2) that climatic disruption poses significant risks to those industries. If either of those premises is not shared by those in power, then all bets are off, although some overseas consumers may have other ideas. But assuming them to be reasonable – and within the remit of governments to influence – what might we do, starting from where we are?

[1] See the accompanying report (PCE, 2024) for details.

Taking an integrated approach

This report argues for taking an **integrated approach** to policies that impact land use. The idea of *integrating* policies is as old as the hills and risks being a piece of tired policy boilerplate.[2] So, what it means in this context needs to be expressed crisply and simply. This report does not hand down a masterplan to achieve better water quality, lower climate impacts and better habitat protection. What I have to say is more about the *process* by which people on the land and those who whakapapa to it can go about implementing changes for the better. It is also about how central and regional governments should both support them and provide a backstop if and when they fail.

Implementing an integrated approach will require growing the capacity of all involved. The environmental impacts of land use need to be treated as an adaptive problem, not a series of technical ones with discrete solutions. This means that the social, economic and cultural dimensions are as important as the environmental one and that multiple actions implemented iteratively will be required.

Dealing successfully with these environmental pressures is only likely to be achieved over a generation or longer. The long-term nature of the challenge has tended to favour aspirational outcomes – something New Zealand is rather good at: net zero emissions by 2050, 90% of rivers swimmable by 2040, a country free of pest predators by 2050. Where we are less successful is in constructing means of implementation that are practical, affordable, fair and capable of consistent monitoring so that we can know whether we are making progress – or not.

In many places, mitigations to existing land use will be sufficient to make progress. For some catchments, improved management as well as land use change targeted at specific hotspots (parcels of land) may be enough to move the environmental dial. Research has shown that implementing up to three mitigations for freshwater contaminants, such as phosphorus, could be achieved at a cost of less than 10% of farm profitability.[3]

But in a few places, wholesale land use change will be needed. We urgently need to develop a shared understanding of those catchments or sub-catchments that are environmentally constrained, and the likely scale of change needed. The communities in question need to buy in to this process.

Based on our case studies and research from Our Land and Water,[4] the majority of land use change should be possible without harming profits or exports. However, successful changes will still likely require public investment in research, monitoring, advice and potentially grants and loans for proof-of-concept projects and the infrastructure required to kickstart land use change (including, for example, processing or water storage).[5] A more diverse landscape could not only improve our environment but also improve the resilience of our communities and economy.

In some cases, land use change will not be economically viable for landowners to undertake. In these cases, landowners should ideally be paid for the ecosystem services that their land use provides (just as they should pay the true cost of the environmental impacts of their existing uses). There has been some talk of payments for biodiversity, but the scale of demand for these is not yet clear. Other unfunded ecosystem services will also become more important, including water regulation and erosion control in flood-prone catchments.

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[2] For other discussions on integrated approaches, see, for example, Hall (2018).

[3] McDowell, 2014.

[4] McDowell et al., 2024.

[5] Noting the earlier caveats about water storage often leading to intensification and worse environmental outcomes overall.

This brings us to this central point, which is often avoided: **someone has to pay**. And we need a coherent and equitable basis for deciding who that is. If no one will, the environment will continue to pay. What costs should lie with landowners? When should public subsidy be available to facilitate land use change, and how should that public subsidy be funded? We have raised several options in this paper, but ultimately these are political questions.[6]

Socialising the costs of land use change is always the easiest route politically, but it can be eye-wateringly expensive. If it required $80 million of public money to reduce the flow of nutrients into Lake Taupō, the sum required to purchase changes in land use intensity across the country on a similar basis would be huge. That is why the first port of call must *always* be finding profitable alternative uses. But it will not always be possible: from our case study work, the cost of restoring one pocket of the Hikurangi repo (wetland) in Northland could be as much as $120 million depending on how you went about it. But just to buy back the land would require nearly $20 million.

Taupō's iconic recreational status provided an urban constituency for such largesse. It is unlikely to be repeated in anonymous reaches of rural Aotearoa devoid of tourist attractions. Before anyone starts planning to spend large sums of public money, the Government should satisfy itself that barriers, some of its own creation, are not standing in the way of a smoother and more affordable transition.

Refocusing climate policy

First among these is to **resolve the tensions that open-ended access to forestry carbon offsets has created for land use**. I do not consider that dedicating land to carbon storage in perpetuity is a sensible course. Because carbon dioxide's residence time in the atmosphere is so long lived, forest offsets have to be maintained forever – a multi-generation guarantee we have no way of making because of the risks of fire, storm damage, disease and human negligence. My reasoning is spelt out at length in *Farms, forests and fossil fuels* and my submission on the recent NZ ETS review.[7]

But removing forestry from the NZ ETS would pose its own problems for land use. In the first place, Māori can rightly claim that it would be yet another kick in the teeth to remove the highest value use of the marginal land they have been left with. Other landowners have invested in good faith. Some form of compensation or transition would be reasonable.

Secondly, marginal land that does not get covered in forestry – productive or otherwise – will likely continue to be farmed, with ongoing costs in the form of erosion, water contamination and habitat loss. Few people are prepared to say so openly, but there are plenty of environmentalists who would count conversion to forestry as the lesser of two evils if it meant improved water quality and lower agricultural emissions. For some of the steepest, most easily erodible catchments this is hard to argue with. So, how else could this land use change be facilitated? There are two avenues, both related once again to climate policy.

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[6] For further discussion of this topic, please see Hall and Lindsay (2021), Hall (2022) and Kedward et al. (2023).

[7] PCE, 2019a, 2023c.

In the first place, **afforestation could be used to mitigate some of the warming effects of agricultural methane emissions**. This could be fully commercial pine production forestry. The detailed reasoning in support of this proposition is set out at length in previous Parliamentary Commissioner for the Environment reports.[8] Here, I will simply remind readers that, unlike carbon dioxide mitigation, a one-off forest planting is all that is needed to offset an ongoing flow of methane emissions. And that if, down the track, the decision is taken to exit livestock farming (and therefore reduce emissions), the trees can in due course be removed. The land's option value is not permanently locked up.

Rather than impose a levy on methane, a methane price could be more effectively imposed if the Government were to **create a separate NZ ETS to manage biogenic methane**. Unlike carbon dioxide, methane does not need to be eliminated – it needs to be dialled back. How much is a political decision to be taken in the context of our national contribution to climate mitigation, but whatever cap is imposed, access to it should be in the hands of the most efficient and productive emitters. Methane offsetting could in this way contribute to land use change – how much would depend on the national cap and the extent to which offsetting was permitted.

Another way to incentivise land use change and habitat protection would be to **commit some of the proceeds from fossil NZ ETS auctions to plant erosion-prone land in native forest**. If offsetting were phased out for fossil emissions, the carbon price would rise and with it the auction revenue raised by the Government. How these proceeds are spent is a political matter. But a case can be made that the rehabilitation and re-creation of habitat would be a worthy destination for some of these funds. After all, the deforestation of Aotearoa is the biggest single contribution humans on these islands have made to increasing the stock of carbon in the atmosphere.

The Government could direct funding to the catchments that are most threatened, and to Māori whose land use choices are most constrained. This would also help shore up highly erodible land as climate change increases the risk of extreme weather events. Having current-day emitters pay to restore some forest seems intuitively reasonable. Planting native trees is a much slower and more expensive way of sequestering carbon, but it is much better for ecological functioning if done well. I'll have more to say on natives and alternative species in a forthcoming report.

Rebalancing decision making

With climate policy refocused – and to some extent the incentives for habitat restoration improved – we are left with the other pressures; most importantly, those degrading water quality.

The difficulty of attributing environmental outcomes from land use at the property level has led to the proposal for all substantive farms to create farm freshwater plans. Depending on implementation, farm plans could be a promising way to encourage the take up of best practice. In particular, farm plans need to be based on good information. However, they are unlikely to encourage land use change. Where plans are ignored, councils can seek to enforce compliance. This is costly, and also means the focus of attention tends to be on the laggards rather than the leaders. The regulatory 'stick' approach alone will not achieve our environmental goals.

[8] *Farms, forests and fossil fuels: The next great landscape transformation?* (PCE, 2019a); *How much forestry would be needed to offset warming from agricultural methane?* (PCE 2022b).

So there need to be some carrots to speed the process along. Economic incentives can be powerful, but property-level market-based mechanisms are limited to outcomes that are objectively measurable and require a revenue source to fund them. Catchments (or sub-catchments) are the level where the environmental impacts of land use are best understood, so it would make sense to offer incentives to those willing to work collectively at this level (especially in the most constrained catchments). This is only possible if we have institutions operating at the catchment level.

Social incentives such as peer pressure can be as powerful as financial ones, particularly if they grow out of grass-roots-based relationships and initiatives that are rooted in the community. Catchment groups are starting to play this role in many parts of New Zealand. The Mataura case study revealed a large network in Southland that has been supported regionally. Catchment groups provide a vehicle for developing a shared understanding of the catchment context, and for willing farmers to learn from each other. The question is how catchment groups can be incentivised to play a larger and more proactive role. This in turn raises the role of regional councils. An example of how this is already working in communities (with some local nuances) is further explained in Box 5.1.

Box 5.1: Iwi leadership in catchment management

Rongomaiwahine Iwi Trust has taken on the responsibility to create catchment groups for the catchments in Māhia, Hawke's Bay, and developed a taiao plan for the whole peninsula. Terence Maru, mana whenua and CEO of the Trust, explains in the quote below that for these plans to be effective you have to mobilise and inspire the whole community, Māori and non-Māori alike:

> "To do this we have to build real relationships and find common aspirations. We won't be popular with all farmers but if we can discuss what really matters on their farms, we will try and assist them and at the same time, also achieve good environmental outcomes."[9]

The Trust plays a significant role in being the conduit between the community and councils, government departments, research institutes and funders. They have put in considerable effort to become a central repository for all environmental data available for Māhia. This information can be used to find solutions to some of their environmental issues, like erosion on steep land and alternative land-use options. Being a conduit works both ways, and this information is only used to inform landowners, not to enforce regulation. Most farms in Māhia are intergenerational, meaning farmers have an intimate knowledge of their land. Experimentation is common and many of the farmers will already know what might work for them on their land.

As Rongomaiwahine whakapapa to Māhia, they are committed to improving the environment and overall health and wellbeing of the community for today and for many generations to come. Taking the leadership in building relationships with external agencies that can provide support to the community is a natural fit.

[9] Terence Maru, CEO of Rongomaiwahine Iwi Trust, pers. comm., February 2024.

Regional councils need to be the conduit between what happens on the ground, and how the centre understands overall progress. Unlike greenhouse gas emissions, water quality, climate adaptation and biodiversity protection are complex, catchment or sub-catchment specific problems. Since every catchment is different, implementation has to be joined up at a catchment level, and that cannot easily be done from the centre. Regional councils, with mana whenua, are best placed to coordinate the work needed, including identifying when implementation is not working and acting as a regulatory backstop.

With a bird's eye view of their catchments, regional councils should work with catchment groups to set the direction of travel in accordance with central government guidance (the *what*). Catchment groups are best placed to determine the on-the-ground actions needed to implement that direction of travel (the *how*). The regional councils' focus should be on supporting catchment groups to understand the problems and how best to solve them. Catchment groups should include mana whenua and any key elements of the local community who can help make things happen.

Farm plans could be made to dovetail with the work of catchment groups, provided the scope of plans is broadened from freshwater to encompass the Government's aspirations across climate change and biodiversity. Catchment groups should be able to focus farmers' attention on the key issues in that catchment, upskill them on ideal mitigation strategies and help them access funding for implementation. As a result, membership of a catchment group should make completing a farm plan easier for farmers. There may even be scope for reducing compliance costs for farmers through collective certification and auditing of farm plans at a catchment level.

Where catchment groups are established, **regional councils need to work with catchment groups and consider, where appropriate, devolving powers (and funding) to those groups**. A key element of any decision to hand some powers to catchment groups is how those groups would be held accountable. What decisions can be left to the catchment group? What regulatory powers stay with the regional council? And what happens if the catchment group fails to deliver?

Taking a relational approach could be useful in this context. A relational approach builds on strong relationships between the parties involved and would recognise the mutual reliance of regional councils and catchment groups in achieving environmental goals. Under this approach the degree of decision making that is devolved depends on the strength of the relationship and the capacity of the catchment group to deliver. A relational approach is a way of dealing with internal and external uncertainty and a way of making the most of shared goals and a desire to collaborate closely. Relational approaches share much in common with Ostrom's design principles (see Box 3.2), and inspired by that, I can see three elements that could make a rebalancing of decision making work in New Zealand:

(1) **Shared goal and outcome setting**. Agreeing to the *what* (i.e. the desired environmental goals and outcomes) must be made clear from the outset. Central government needs to provide a framework for catchment groups and regional councils to collaborate and to ensure local self-interest does not take over. This framework may include information and process requirements and standards for environmental limits, and outcomes to be achieved. Within this framework, landowners, communities and mana whenua must ensure that the outcomes are realistic and achievable for their circumstances and specific contexts.

(2) **Action and implementation**. The *how* is led and driven by landowners, local communities and mana whenua. Local people hold important relationships, knowledge and skills and have skin in the game. If they can be persuaded to buy into a problem, they will often be able to solve it with more agility, innovation and durability than when solutions are handed down from above. Regional councils and central government can provide support in the form of information, research, and access to experts, tools and resources (ideally with central government providing financial, scientific and technical support). It is useful if actions and implementations are based on a set of shared principles or values, which can reduce the scope for conflict among stakeholders.

(3) **Monitoring, compliance and sanctions**. These three interrelated tasks pertain primarily to central government and regional councils to ensure that the shared goals and outcomes are being worked towards as agreed. Regulatory attention should primarily be focused on those that are unwilling to take part in collaborative catchment processes. Any problems with the collaborative process itself need to be flagged early, and it is therefore crucial to have processes in place for communication, negotiation and resolution of conflicts. Ideally, issues will be sorted out within the catchment groups themselves with regional and central government intervention as a last resort.

Central government has additional vital roles to play.

Everyone – regulators and regulated alike – need cheap, easy access to high-quality environmental information. This is a public good that isn't easily provided by individuals acting alone. Catchment groups (and individual farmers) need to be able to model the impact of different actions and be easily able to identify areas where land use change will yield higher than average benefits. The quid pro quo is that in return, landowners and catchment groups need to be prepared to share the details of their practices and resource use.[10] Monitoring and auditing has to generate information that can tell us, collectively, if we are making a difference at the level of the catchment, rather than just become an inventory of farm-level box ticking.

Central government should make all this information accessible and underwrite it as a public good. Farmers and regional councils should be able to access the same information free of charge. Rolling out farm plans nationwide is an ambitious undertaking that will founder if they rely on expensive access to inadequate data. We seem to be dazzled by physical infrastructures and their multi-billion-dollar price tags. Information is a piece of weightless infrastructure that is orders of magnitude cheaper and likely to yield both economic and environmental benefits that cannot be captured by individual parties.

[10] Provided it is anonymised and they have some control over who accesses it and how it is used.

Removing barriers to land use change, especially water

Central government needs to finance and remove the barriers to land use change. One key barrier to land use change is access to water. Where water is scarce, rights to use it should be transferable. Scarcity creates value, and that value is currently capitalised in the value of land to which use rights attach. This confers first-in-time privileges and locks in existing uses.

The development of tradable water rights should be investigated. That would simultaneously require a resolution of Māori interests in water. That is not something the country should fear. A wise agreement between Māori and the Crown could provide both parties with the means to invest in improving water quality (with flow-on benefits ranging from spiritual values to opportunities for mahinga kai) by paying for ecosystem services. Resource rentals are a sound means of ensuring that scarce resources are used wisely. If that proved impossible, something along the lines of the land use intensity tax described in chapter four could be considered. But one way or another, water needs to be used more efficiently and the financial resources to effect changes in the way we use land need to be mobilised. It will not happen for free.

Planning restrictions that unnecessarily hinder land use change should also be investigated.

Prioritising and experimenting

Effort and money need to be focused on the catchments or sub-catchments where the pressures are greatest and where the biggest changes are required. This is unlikely to be achieved by decree. From both a national and a regional perspective, we need to make progress where we are most at risk rather than advance incrementally everywhere at the pace of the slowest traveller.

The Government should take an experimental approach. Committing to provide high-quality, freely available land and water information to all land users should be universal. But without discarding the progress that has been made through successive iterations of the National Policy Statement for Freshwater Management, the focus beyond that should be on a small number of particularly difficult catchments. These have been identified (see chapter two) and are unlikely to be brought in line through incremental regulatory tweaks. An investment in information, catchments groups and some of the allocation mechanisms discussed above should be trialled. They will almost certainly not work perfectly – there has to be learning by doing. But taking that approach ensures that we are focused squarely on implementation rather than aspiration.

A final word

Whatever the resourcing required to effect change, it can only be attempted by working very closely with land users, who are already contributing and will have to contribute more. This is where effective catchment groups that can take real decisions become important. Their detailed local knowledge can make the best use of fine-grained land information to channel investments to the parts of the landscape that will make the most difference.

No government will have ready answers to the many questions posed here. That is not to be expected. But equally, no government should avoid asking the hard questions. If the answers prove too hard to implement, then so be it. But at least we would have been honest about why environmental decline continues.

I am optimistic that know-how on the ground, research into new techniques and new land uses, and a massive improvement in our ability to manipulate land-based information could improve environmental performance. I am less optimistic about the capacity of our institutions to deliver the sort of socially and economically informed understandings we need to address our problems. But I am very happy to be proved wrong.

Polystichum wawranum

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This report has been produced pursuant to subsections 16(1)(a) to (c) of the Environment Act 1986. The Parliamentary Commissioner for the Environment is an independent Officer of Parliament, with functions and powers set out in the Environment Act 1986. His role allows an opportunity to provide Members of Parliament with independent advice in their consideration of matters that may have impacts on the environment.

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