KELLOGG RURAL LEADERSHIP PROGRAMME I COURSE 42, 2021

UNTAPPED POTENTIAL

OPPORTUNITIES AND CHALLENGES FOR WATER STORAGE IN NEW ZEALAND.

KELLOGG RURAL LEADERSHIP PROGRAMME

AARON LETCHER

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Who knew babies and Kellogg Scholars had the same 9-month gestation period?

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1: Executive Summary.

Water is set to become the defining issue of the twenty-first century. As global populations continue to rise and the impacts of climate change become more acute, our freshwater resources will increasingly come under pressure.

As demand begins to exceed supply access to water, or a lack thereof, will likely lead to increased social and political instability and tensions between neighbouring countries – particularly when there is a shared water resource involved.

Although New Zealand is unlikely to face some of the more extreme challenges that will arise globally, we will still have our own unique issues to overcome as a country. Already we are beginning to feel the impacts of a changing climate with more extreme weather patterns.

In 2020 much of the country experienced what many described as the worst drought on record. The issue is, this drought was not the only catastrophic drought in living memory – in fact, it wasn't even the only catastrophic drought to hit New Zealand in the past decade. Only seven years earlier we had experienced similar scenes across much of the country.

At face value it may seem like New Zealand is running out of water, but to say water is running out of New Zealand would be closer to the truth. We have more than enough freshwater resources to meet all of our needs, we just fail to capture them for efficient, sustainable, strategic, and productive use.

We are fortunate to live in one of the most water abundant countries in the world by almost any measure: precipitation per year (43rd), water per square kilometre of land (18th), or water per head of population (7th). New Zealand has approximately 440,000 million cubic metres available for our use each year. The problem is we only capture around 3% of it for productive use. The rest makes its way down our network of rivers and flows out to sea.

As a country we receive more than our 'fair share' from the global endowment of freshwater and I would argue that that brings with it an obligation to use that water efficiently not only for our own benefit, but for the benefit of others on the planet.

The impacts of climate change are only going to continue to get worse with higher temperatures, longer droughts, and more extreme rainfall. We won't get enough water when we need it, and we will get too much when we don't. This only strengthens the case for capturing the water while we can and storing it for when we need it.

Increased water storage will bring with it other benefits like increased hydro capacity. While some of our larger hydro damns have considerable storage capacity e.g., Benmore, Clyde, and Manapouri, we actually have a relatively small storage capacity of 4TWh vs annual inflows of 24TWh.

It will also open up the possibility of increased land use flexibility that may reduce some of our current environmental pressure like methane and nitrates and allow some landowners to transition to a land use that will give them greater returns per hectare. This is particularly true in Northland where we have an opportunity to ease economic deprivation by harnessing their existing soils and climate.

The opportunities are significant but before we can unlock our untapped potential, we do have some challenges that we will need to collectively overcome: a lack of an overarching national water storage strategy, political uncertainty, financial barriers, an unfounded fear of dairy intensification, and the ever-present question of Māori rights and interests in water.

2: Water in a global context.

Some have described water as the defining crisis of the twenty-first century[1], while others have described it as the currency of global success.[2] Although these two statements may sound diametrically opposed at first glance, both are likely to ring true in the coming years.

How people come to view freshwater resources this century will be determined by where they live with a clear distinction between the 'Haves' and the 'Have Nots'.

The world's current population of 7.6 billion people is forecast to grow to 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100. [3] The vast majority of this increase is forecast to occur in the developing world, particularly Africa.[4]

UN reports suggest that this population rise, increased urbanisation, the impacts of a warming climate and changing diets will dramatically increase the demand for water.[5] Sustaining that level of population growth is going to put enormous pressure on our freshwater resources as demand begins to exceed supply in many parts of the world.[6] This will create global tension.

According to a U.S. intelligence community assessment of global water security "one third of the world's population will live near water basins where the water deficit will be larger than 50 percent by 2030"[7] and annual global water requirements will exceed current sustainable water supplies by 40%.[8]

They believe it is highly likely that during the next decade water shortages will contribute to social and political instability and could possibly contribute to state failure in some instances as tensions rise over diminishing aquafers, shared river basins and the blockage or impediment of river flows from upstream states. We are already seeing tensions rise as countries with shared resources begin to strategically manoeuvre in preparation for future challenges.

In 2011 Ethiopia began construction of the largest hydroelectric dam in Africa, the Grand Ethiopian Renaissance Dam. This project will allow for the irrigation of crops for the growing nation and more than double their electricity-generating capacity with clean, green, renewable energy. This issue is that although the genesis of the Nile can be found in Ethiopia, its waters flow through both Sudan and Egypt further downstream sustaining both countries people and economies. Although a resource sharing agreement has been put in place, it is still early days.[9]

There is also the potential for tension to arise in Asia with five of the world's greatest rivers flowing through China: the Mekong, Brahmaputra, Irrawaddy, Salween, and Indus. Although historically

[1] Pearce, Fred. (2006). When the rivers run dry: water, the defining crisis of the twenty-first century. Boston: Beacon Press.
[2] Muller, Todd. (2020). Water will be the currency of the 21st century. The Country.
[3] United Nations Department of Economic and Social Affairs. (2019). World Population Prospects: The 2019 Revision.
[4] U.S. Department of State. (2012). Intelligence Community Assessment: Global Water Security.
[5] United Nations Environment Programme. (2016). Press Release: Half the World to Face Severe Water Stress by 2030 unless Water Use is "Decoupled" from Economic Growth, Says International Resource Panel.
[6] Ibid.
[7] U.S. Department of State. (2012). Intelligence Community Assessment: Global Water Security.
[8] Ibid.
[9] Pearce, Fred. (2006). When the rivers run dry: water, the defining crisis of the twenty-first century. Boston: Beacon Press, Chapter 23.

China has not dammed rivers with downstream neighbours, population pressures and huge demand for irrigation and electricity is driving a change in policy.[10]

Critically, China was one of only three countries that refused to sign an international agreement on cross-border rivers. They maintain that they have "indisputable territorial sovereignty over those parts of international watercourses that flow through its territory"[11]. In other words, they say the water belongs to them. This could lead to future regional tensions particularly as some of those waterway's flow through the other Asian superpower of India. Only time will tell how this plays out.

3: Water in a New Zealand context.

Here in New Zealand, we don't have these same kinds of complex challenges to grapple with. We are blessed to be a small island nation tucked away at the bottom of the pacific with no shared land borders - and therefore no cross-border rivers. The freshwater issues we face are relatively benign when compared to the global context, but we do still face issues.

New Zealanders have a special connection to our water. We don't just rely on it to maintain our health, produce our food, and generate our energy – it also underpins our outdoor lifestyle and our clean, green international brand.[12] Water is the lifeblood of our national economy.[13] Each individual's relationship with water will be different depending on whether you live in a rural or urban area and the recreational activities you participate in like swimming, kayaking, and fishing.

Most issues relating to water domestically tend to focus on water quality, rather than water quantity and allocation – although that has begun to change recently. In 2018 the Government announced their Essential Freshwater work programme setting out their plan for healthy water, fairly allocated.[14] The plans objectives are to:

- Stop further degradation of New Zealand's freshwater resources and start making immediate improvements so that water quality is materially improving within five years.

- Reverse past damage to bring New Zealand's freshwater resources, waterways, and ecosystems to a healthy state within a generation.

- Address water allocation issues, by working to achieve efficient and fair allocation of freshwater resources, having regard to all interests including Māori, and existing and potential new users.[15]

In September 2020, a new National Policy Statement for Freshwater Management was put in place by the current Government to provide local authorities with direction on how to manage freshwater under the Resource Management Act 1991.

[10] Ibid at page 164.
[11] Ibid.
[12] Fish & Game New Zealand. (2021). Water Storage and Irrigation.
[13] KPMG New Zealand. Water and people: The different ways we interact and use water. (2016).
[14] Ministry for the Environment. (2018). Essential Freshwater: Healthy Water, Fairly Allocated.
[15] Ibid.

This was accompanied by new National Environmental Standards for Freshwater, stock exclusion regulations, and water measurement and reporting regulations that local authorities are also required to give effect to.[16]

These regulations directly address the first two objectives of the Essential Freshwater Programme; however, they do not address the issue of freshwater allocation. It is anticipated that this issue will emerge as a prominent topic this term of Parliament.

4: Allocation issues.

The challenge is that demand for water is increasing – whether that be for agriculture, horticulture, industry, or municipal purposes.[17] Just as the global population is increasing, so too is our national population here in New Zealand.

Stats NZ projects our current population could grow from our current base of 5 million to 5.5 million by 2025. The same projects suggest we could be close to 6 million by 2030. Taking a longer-term view, our population may exceed 7 million by 2050, and 8.5 million by 2075.[18]

Our demand for water will only continue to increase as our population, and our agriculture-based economy, continue to grow.[19] We have already seen a huge increase in water demand from our primary sector over the past two decades with our level of irrigated land increasing by approximately 70% between 2002 and 2017.[20]

Demand for urban water use also continues to increase rapidly fuelled by the record rate of population growth mentioned above and increased urbanisation. More than 86% of our population now reside in urban areas.[21]

As these pressures continue to compound conversations have begun discussing whether we have an appropriate water allocation framework in place to determine who has the right to take water, how much they can take, and when they can take it. The current approach is essentially a 'first in, first served' model.

There are also unresolved issues relating to Māori freshwater allocation and our obligations under Te Tiriti o Waitangi (the Treaty of Waitangi). Historical circumstances around Māori land ownership, such as fractional title and delayed treaty settlements, have impeded the development of land by iwi and hapu and they have ended up at the 'back of the queue' when it comes to access to water.[22]

This raises questions of allocation equity, whether allocation has been made in the best interests of the water body/environment, and whether we need to be allocating water to the highest value use to help grow NZ Inc. At some stage we will likely need to revisit the way we 'divide the pie' or consider growing the size of the pie so everyone can eat.

[16] Ministry for the Environment. (2020). About the National Policy Statement for Freshwater Management.
[17] Ministry for the Environment. (2017). Briefing to the Incoming Minister for the Environment: Water Issues.
[18] Stats NZ. (2020). National population projections: 2020 (base)–2073.
[19] Ministry for the Environment. (2017). Briefing to the Incoming Minister for the Environment: Water Issues.
[20] Ibid.
[21] Water New Zealand. (2017). New Zealand Water Consumer Survey Report. Page 14.
[22] Ministry for the Environment. (2017). Briefing to the Incoming Minister for the Environment: Water Issues.

5: The importance of water for Māori.

For Māori, water is the essence of all life. It is water that supports all people, plants, and wildlife.

Māori assert their tribal identity in relation to particular waterways, rivers, and lakes that they have an ancestral connection to whether that be as a means of travel or a source of mahinga kai.[23] Although there are many different narratives of water across Māoridom, there is a universal overarching acknowledgement and theme that water is tapu (sacred).

Te Ao Māori, the Māori world view, is underpinned by the importance of Whakapapa (genealogy) that connects us all together.[24] Relationships – whakapapa – are regularly cited as a foundational principle of Te Ao Māori.[25] This world view acknowledges the interconnectedness and interrelationship of all living and non-living things.[26] According to the Māori creation story:

"Water first manifests in this genealogy as Wainuiātea – the great expanse of water, the gathering of all waters – who was the first partner of Ranginui, the Sky Father. Freshwater first appears as a consequence of the parting of Ranginui, Sky Father, from Papatūānuku, Earth Mother. Their grief and yearning for each other presents as the teardrops (rain) of Ranginui and the sighs (mist) of Papatūānuku."[27]

When considered in the context of the Māori creation story, and how water is positioned in that narrative, it is easy to understand why water is viewed as being sacred. Water is a taonga (treasure) of huge importance to Iwi who strongly believe they have a right of tino rangatiratanga (sovereignty) and a responsibility of kaitiakitanga (guardianship).

6: Māori rights and interests in water.

Traditional Māori society did not have a concept of absolute ownership of resources; however, they did have a system of customary title that conveyed rights of usage. Upon the signing of the Treaty of Waitangi, New Zealand began operating under the common law tradition and constitutional framework inherited from the English legal system.[28]

As part of that inherited common law system there is an existing doctrine of native title which holds that ownership vested in the Crown is subject to existing native rights.[29] Although a judgement in the case of *Wi Parata v The Bishop of Wellington* (1877) ruled that there was no application for this title in New Zealand[30] this decision has since been overruled.

A Court of Appeal judgement in the case of *Attorney-General v Ngati Apa* (2003) ruled that the arrival of British common law in New Zealand did not necessarily extinguish Maori customary title. The question that has since arisen as to whether Maori customary title to fresh water remains the property of Maori in accordance with the doctrine of native title.

[23] Te Runanga O Ngai Tahu. (2020). Freshwater Policy.
[24] Joy, M., Ngata, T., & Kim, N. (2018). Mountains to Sea. Adfo Books. Chapter 2.
[25] Ibid.
[26] Our land and water. (2020). Te Ao Māori.
[27] Joy, M., Ngata, T., & Kim, N. (2018). Mountains to Sea. Adfo Books. Chapter 2.
[28] Courts of New Zealand. (2020). Our court system.
[29] Ruru, Jacinta. (2010). Maori legal rights to water: Ownership, management, or just consultation? University of Otago.
[30] Wi Parata v The Bishop of Wellington (1877) 3 NZ Jur (NS) 72.

In 2012 the New Zealand Māori Council, along with other claimants, lodged two claims with the Waitangi Tribunal arguing:

"Māori have unsatisfied or unrecognised proprietary rights in water, which have a commercial aspect, and that they are prejudiced by Crown policies that refuse to recognise those rights or to compensate for the usurpation of those rights for commercial purposes". [31]

In 2013 the Crown acknowledged to the Supreme Court that Māori have rights and interests in water and was "open to discussing the possibility of Maori proprietary rights in water, short of full ownership"[32]

It was argued that the best way forward was not to develop a framework for Māori proprietary rights but to strengthen the role and authority of Māori in resource management processes.[33]

More recently Cabinet have put in place a new approach to the Crown/Māori relationship for freshwater based on the following principles:

- The Crown and Māori have a key shared interest in improving the quality of New Zealand's freshwater, including the ecosystem health of our waterways.

- The Crown and Māori have a shared interest in ensuring sustainable, efficient, and equitable access to and management of freshwater resources.

- The Crown acknowledges that Māori have rights and interests in freshwater, including accessing freshwater resources to achieve their fair development aspirations for under-developed land, however the Crown also acknowledges that existing users have interests that must be considered.

- The Crown will work with Māori and regional government to consider how, on a catchment-by-catchment basis, freshwater resources can be accessed fairly so as to achieve the development of under-developed land.

- No one owns freshwater – it belongs to everyone, and we all have a guardianship role to look after it. [34]

We can expect the topic to be highly politicised and this will only be heightened by the return to Parliament of the Māori Party with two MP's and a strong and influential Māori Caucus within the Labour Party who make up a quarter of the Cabinet and one fifth of Labours Caucus as a whole. The issue has the potential to be just as controversial and divisive as the seabed and foreshore debate of 2004.

7: Who owns the water?

The principle that nobody owns freshwater is based on a well-established common law principle that there is no property in flowing water. This common law tradition can trace its roots back to the

[31] Waitangi Tribunal. (2012) Wai 2358.
[32] New Zealand Maori Council v Attorney-General [2013] 3 NZLR 31
[33] Ruru, Jacinta. (2012). Māori Law Review: Māori rights in water – the Waitangi Tribunal's interim report.
[34] Cabinet Paper. (2018). A new approach to the Crown/Māori relationship for freshwater. ENV-18-MIN-0032

Romans who denied the possibility of private ownership of running water but did recognise rights for the use of the resource and that regulation was needed to prevent over-exploitation.[35]

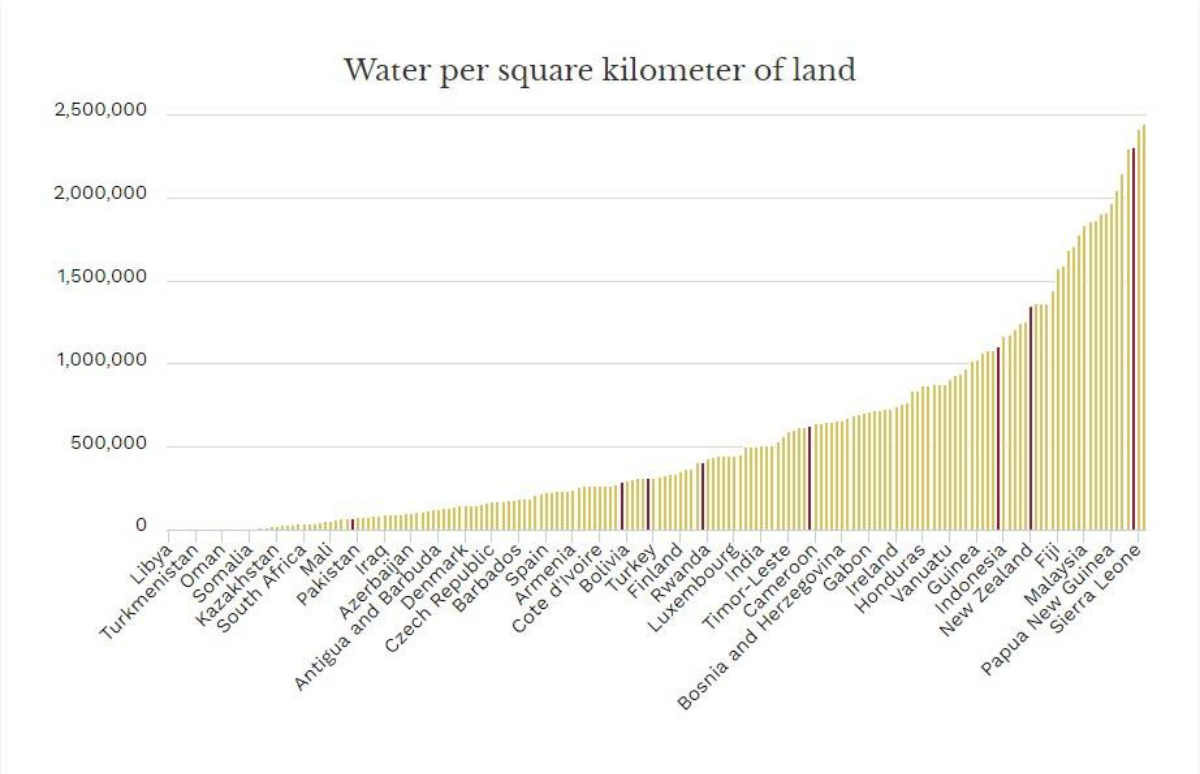
8: How much water does New Zealand actually have?

New Zealand is one of the most water abundant countries in the world by almost any measure.

On a precipitation (mm) per year basis, New Zealand is ranked at number 43 with 1732mm of rain.[36] For comparison, the global average is 1155 mm per year. We ranked significantly higher than other countries such as the UK (70th, 1220mm), USA (107th, 715mm), China (117th, 645mm) and Australia (136th, 534mm).[37]

On a water per square kilometre of land basis we rank in the top 20 globally with 1,345,370 cubic metres of renewable freshwater per square km.[38] This means we have twice the freshwater density of the United Kingdom and roughly four times the freshwater density of China, the USA, and the global average. On average New Zealand receives about twenty times the volume of freshwater per square kilometre of area than Australia does.[39]

Figure 1:



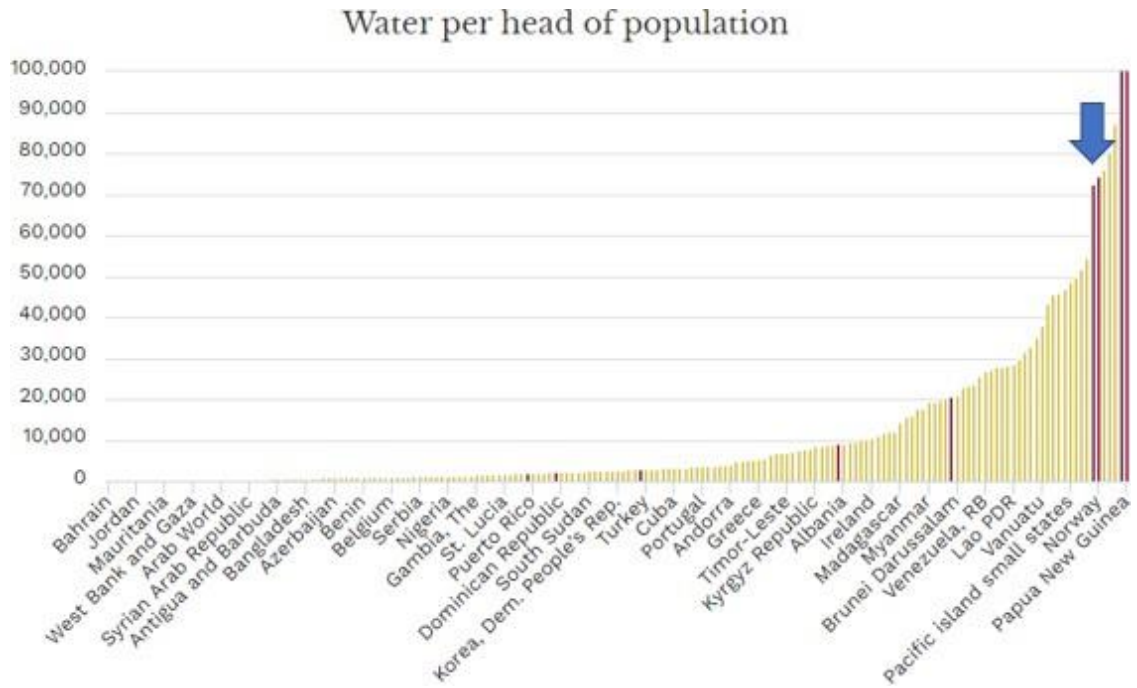
Source: https://berl.co.nz/our-foundation/freshwater-new-zealand-2-new-zealand-world-water

[35] Getches, D.H. (1997). Water Law in a Nutshell. West Publishing, St. Paul, Minn. page 16.
[36] Precipitation by country, around the world | TheGlobalEconomy.com
[37] Ibid.
[38] United Nations Food and Agriculture Organisation. (2020). AQUASTAT Database.
[39] Sanderson, Kel. (2019). Freshwater in New Zealand (2) - New Zealand in a world of water.

When examined on a water per head of population basis, New Zealand fares even more favourably. We have the 7th highest amount of freshwater per head of population with 72,510 cubic metres of renewable freshwater per square km.

To offer some perspective, New Zealand receives over 38 times the amount of water per person in China, 32 times the amount of water per person in the United Kingdom, 8 times the amount of water per person in the USA, and more than 3 times the amount of water per person in Australia. [40]

Figure 2:



Source: https://berl.co.nz/our-foundation/freshwater-new-zealand-2-new-zealand-world-water

By any of the measures above it is clear that in terms of freshwater resource endowment New Zealand receives our fair share – if not more – from the planetary quota. In light of the global context and our apparent abundance of freshwater resources it could be argued that we have an obligation to use it efficiently not only for our own benefit, but for the benefit of others on the planet.[41]

9: How much water do we currently capture?

At face value it may seem like New Zealand is running out of water, but the reality is that water is running out of New Zealand. We have more than enough freshwater resources to meet all of our needs, we just fail to capture them for efficient, sustainable, strategic, and productive use.

New Zealand's average volume of precipitation (rain, hail, sleet, and snow) between 1995 and 2014 was approximately 550,000 million cubic metres – although it should be noted that the annual precipitation was less than this average in nine of the years between 2000 and 2014 due to changing climate patterns.[42]

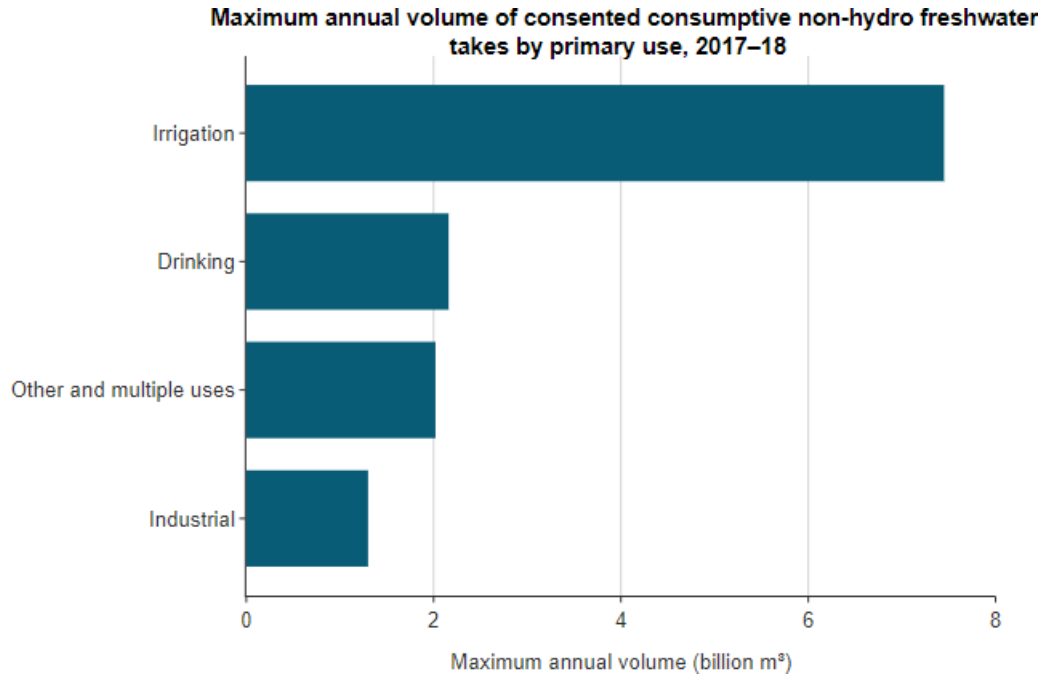
[40] United Nations Food and Agriculture Organisation. (2020). AQUASTAT Database.
[41] Sanderson, Kel. (2019). Freshwater in New Zealand (2) - New Zealand in a world of water.
[42] Stats NZ. (2018). System of Environmental-Economic Accounting (SEEA) water physical stock account).

Although our total precipitation may be 550,000 million cubic metres, we need to account for evaporation as part of the usual hydrological cycle. In New Zealand approximately 20% of our water, or 110,000 million cubic metres, evaporates after it lands.

The remaining 80%, approximately 440,000 million cubic metres, is left to flow down our rivers and recharge our aquafers. Some of this will be captured as used, however the majority will eventually flow out to sea.

The maximum annual volume of consented consumptive non-hydro freshwater takes by primary production use, 2017-18 was 13,000 million cubic metres per year.[43] This includes all water for irrigation, drinking, industrial and other/multiple use takes. Non-consumptive hydropower consents were excluded from this analysis because they do not alter average river flow as their rates of take were generally equivalent to their rates of discharge back into the river network.[44]

Figure 3:



Note: Hydro use is generally non-consumptive and has been excluded from volume comparison. Drinking use includes household, town, and rural water supply; industrial use includes commercial, industrial, mining, and aquaculture uses; other and multiple uses includes frost protection, stock, storage, and consents for multiple uses.

Source: https://www.stats.govt.nz/indicators/consented-freshwater-takes

Our largest maximum consented consumptive take is from irrigation at 7,450 million cubic metres per year. This is followed by drinking water (2,160 million cubic metres), Other/multiple uses (2,020 million cubic metres) and industrial users (1,300 million cubic metres).

[43] Stats NZ. (2020). Consented freshwater takes.
[44] Booker, D, & Henderson, R. (2019). National water allocation statistics for environmental reporting; 2018.

Based on the figures above New Zealand currently captures just under 3%[45] of our water for consumptive use. This highlights the huge opportunity that we have as a country to strategically capture and productively use a greater percentage our freshwater resources. So, why aren't we capturing more?

Throughout the remainder of this paper, I will explore the opportunities increased water storage presents for our country, the challenges and barriers that are preventing us from realising those opportunities and provide some clear recommendations for the future.

The first immediate opportunity for increased water storage in New Zealand is to help protect against the impacts of drought.

10: What is a drought?

Drought is a term that is often thrown around loosely in the media or at backyard barbeques to describe any prolonged period of low rainfall, however this is an overly simplistic characterisation of the issue that does not do it justice. Although at its simplest drought can be thought of as "a severe decrease in water availability below what is expected"[46] there is a more nuanced description for these devastating weather event.

Droughts differ from other weather events, such as storms, because of their extended, rather than short and sharp, effect.[47] They can have a slow, gradual onset with no clear 'start' and often have no clear 'end' either. They can occur over a single season or last several years as we recently saw in Australia (2016 – 2020).

Droughts can be broadly categorised into four groups/types: meteorological, hydrological, agricultural, and socioeconomic.[48] The first three of these categories consider drought as a physical phenomenon, whereas the last category considers the effect of the water deficit as it ripples through socioeconomic systems.[49]

The following definitions have been taken from the US National Drought Mitigation Center: [50]

Meteorological drought:
Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. Definitions of meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

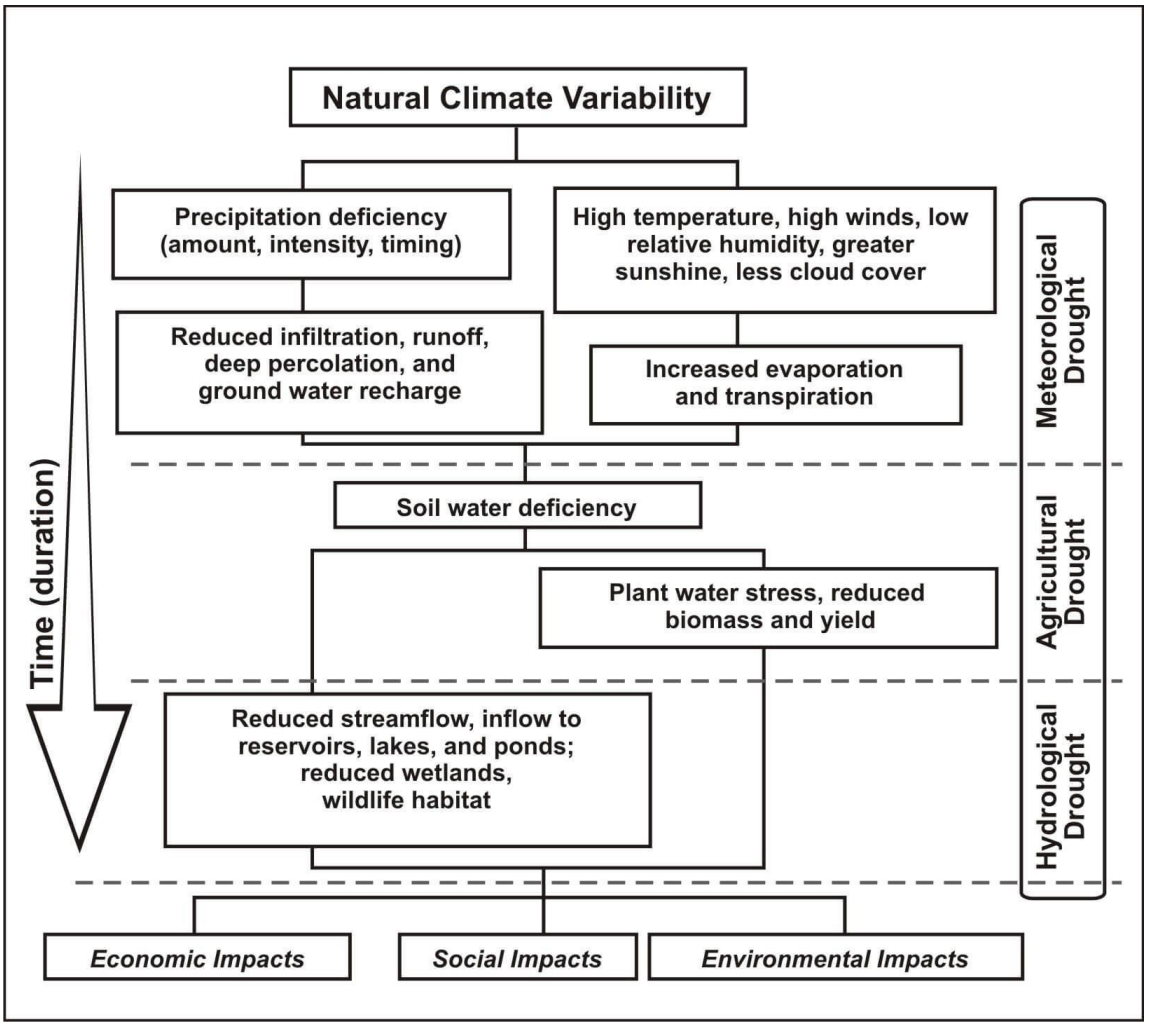
Agricultural Drought:
Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, and so forth.

[45] 2.9545%.
[46] Clark, A, Mullan, B., & Porteous, A. (2011). Scenarios of Regional Drought under Climate Change. NIWA.
[47] Ibid.
[48] Wilhite, D.A.; and M.H. Glantz. (1985). Understanding the Drought Phenomenon: The Role of Definitions. Water International 10(3):111–120.
[49] National Drought Mitigation Center. (2021). Types of Drought.
[50] Ibid.

Hydrological Drought:
Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system.

Socioeconomic Drought:
Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. It differs from the aforementioned types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.

Figure 4:



Sequence of drought occurrence and impacts for commonly accepted drought types. All droughts originate from a deficiency of precipitation or meteorological drought but other types of drought and impacts cascade from this deficiency.

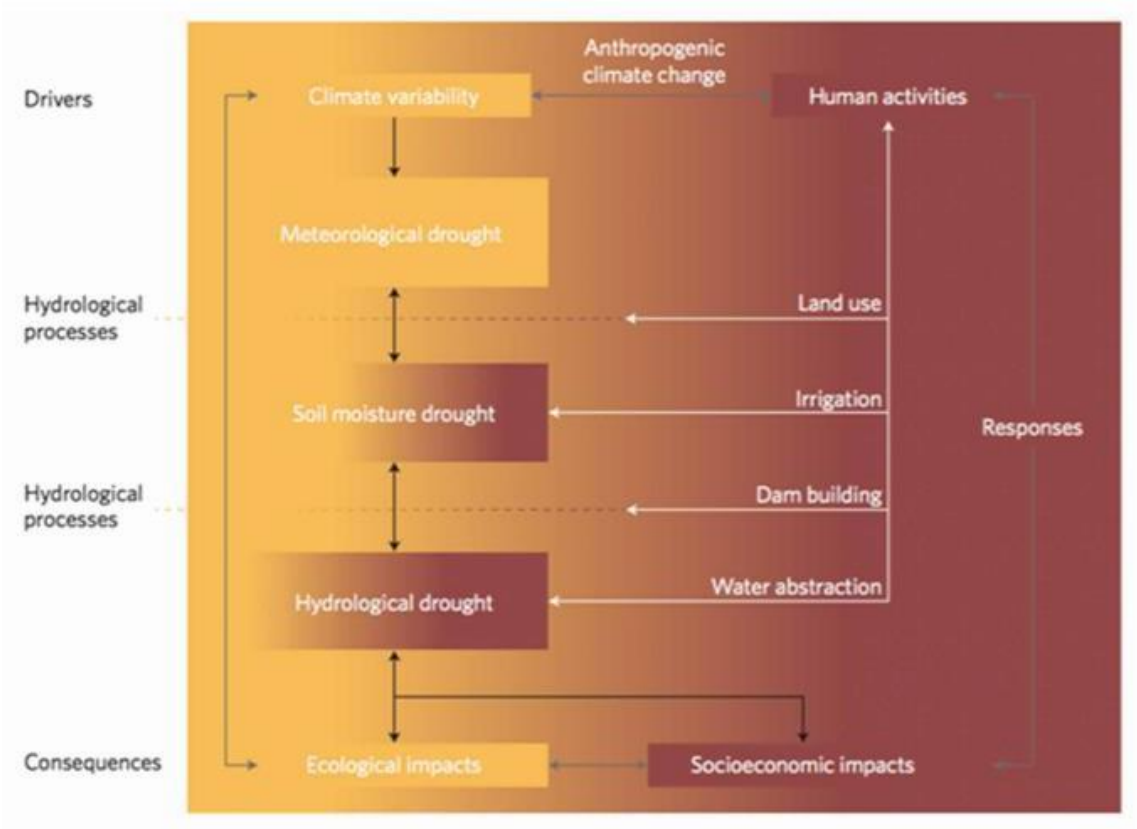
Source: US National Drought Mitigation Center.[51]

[51] Ibid.

11: Other factors at play.

Generally, when people discuss drought, they are referring to meteorological drought, however human activities can also have a significant impact on the water cycle. “Hydrology and soil moisture are affected by how much water we extract or divert, how we use that water, and how we use the land. Management of dams, changing land cover, and the choice of drainage type all have an effect.[52]

Figure 5:



Reference: Drought system (Van Loon et al., 2016) Van Loon, A. F., Gleeson, T., Clark, J., Van Dijk, A. I., Stahl, K., Hannaford, J., … Uijlenhoet, R. (2016). Drought in the Anthropocene. Nature Geoscience, 9(2), 89.

12: Our most recent drought (2020).

Concerns about drought and access to water were front of mind for many New Zealanders during 2020 – and it wasn’t just farmers and growers. Urban communities were also severely impacted.

Although the summer months of December through February are typically the driest months for New Zealand, the 2019/20 summer season was exceptionally dry with much of the North Island

[52] MOTU economic and public policy research. (2018). Drought and climate change adaptation: Impacts and Projections.

experiencing severe meteorological drought.[53] Unfortunately the coming months did not bring any reprieve and the effects continued to compound.

NIWA data shows that this was one of the most severe droughts to hit New Zealand since the early 20th Century[54] with large swathes of the North Island and upper South Island, from Northland to Canterbury, facing decreased rainfall and high temperatures.

The Waikato, one of our largest agricultural regions, saw 61 continuous days without rain. This was one of the most severe droughts on record for the region.[55] Similarly, the Far North went 65 days without rain.[56] The pattern was clear right across much of New Zealand – and it wasn't just our agricultural regions who were feeling the pressure.

An aerial photo of the Waikato region in February 2020. Photo credit: Sarah Fraser, NIWA.

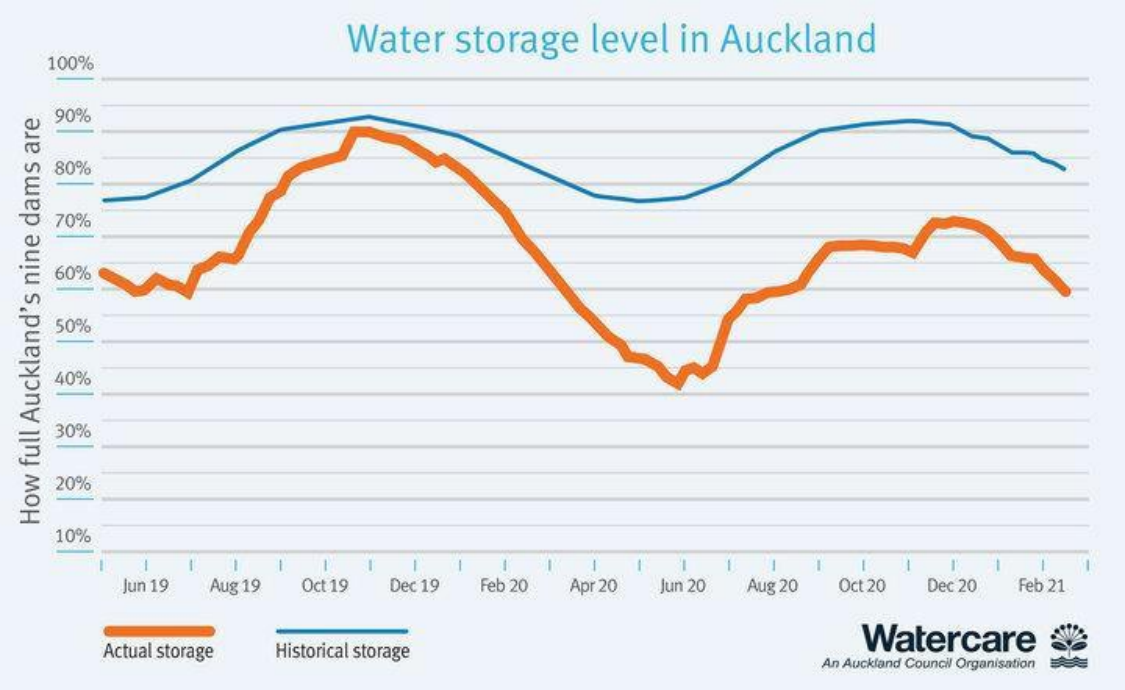
13: A water crisis for our largest city?

Auckland, our largest city with a population of more than 1.7 million people[57], also experienced severe drought in 2020. The region went 77 continuous days without rain – their driest summer since records began.

[53] NASA Earth Observatory. (2020). New Zealand Browned by Drought.
[54] NIWA Media Release. (2020). Auckland's drought most extreme in modern times.
[55] Ibid.
[56] NIWA Media Release. (2020). Drought hits hard, far, and wide.
[57] Infometrics. (2020). Auckland's economic profile: Population growth.

Rainfall is crucial for Auckland to replenish their dams, but between November 2019 and May 2020, Auckland received 40 per cent less rain than normal.[58]Unfortunately, the high temperatures and lack of rain lead to a predictable increase in water use across the city and by April the cities total volume of water stored in their dams had dropped below 50 per cent for the first time in more than 25 years.[59]

Figure 6:



Source: https://www.watercare.co.nz/Water-and-wastewater/Drought-response

14: This had happened before (2013).

In 2013 we experienced extremely low levels of rain throughout the summer period leading to what many described at the time as the worst drought in our national history.[60] Throughout that summer we saw record low rainfall for parts of Northland, Auckland, and the Bay of Plenty.

There was widespread dryness with less than a quarter of normal February rainfall in Gisborne, Hawkes Bay, Taupo and the West Coast, and half normal rainfall in most other regions around the country. [61] Much of New Zealand was experiencing widespread and severe drought by late February.

The situation continued to worsen with no rain in March and the first half of April.[62] Rain finally came in mid-April, but the damage had already been done.

[58] Watercare. (2020). Drought response: The impact of the drought and our planned response.
[59] Ibid.
[60] Johnston, Kirsty. (2013). North Island drought worst in history.
[61] NIWA. (2013). Climate Summary for February 2013.
[62] NASA Earth Observatory. (2013). Drought in New Zealand.

Just as Auckland had their municipal and domestic water supply threatened by the 2020 drought, Wellington had a similar experience in 2013 and same very close to running out of domestic drinking water.[63]

15: Drought in New Zealand.

As you will have seen above, drought isn't a new concept to New Zealanders – particularly those who work in our primary sector.

Statistics New Zealand and NIWA assessed the prevalence of different types of drought in New Zealand at a select 30 sites over the last decade (2010 – 2019) using a Standardised Precipitation-Evapotranspiration Index (SPEI) indicator which incorporates temperature and precipitation to measure drought events.[64]

They found that 23 of the 30 sites spent at least 25 percent of the time in a hydrological drought event with 5 sites having been in a drought event for at least 50 percent of the time (Dannevirke, Kerikeri, New Plymouth, Reefton and Taupō).[65]

16: The impacts of drought.

Clearly New Zealanders have been living with regular periods of drought conditions for quite some time as a recurring natural disaster. Droughts, unlike other forms of natural disaster, are long-term events that may have chronic effects.[66]

Drought already has a far-reaching impact on New Zealand society and our activities including our three waters (water supply, wastewater, and storm water)[67], primary production (including agriculture, horticulture, fisheries and forestry), industrial use in processing and manufacturing, and electricity generation.[68]

It is entirely possible that increased prevalence of drought may be the climate change impact with the greatest effect on our national economy[69] with a recent report estimating the direct economic loss as a result of drought in the decade 2007 – 2017 at $720 million.[70]

That being said, the impacts of drought are more than just financial and can affect our health in several ways. Drought may reduce the availability of fresh food, increase the likelihood of gastrointestinal infections such as cryptosporidiosis and giardiasis through a greater concentration of

[63] Harrington, L. J., Gibson, P. B., Dean, S. M., Mitchell, D., Rosier, S. M., & Frame, D. J. (2016). Investigating event-specific drought attribution using self-organizing maps. Journal of Geophysical Research: Atmospheres, 121(21).
[64] Stats NZ. (2020). Drought Indicators.
[65] Ibid.
[66] Sartore, Gina-Maree. (2007). Drought and its effect on mental health. Australian Family Physician Vol. 36, No. 12.
[67] OECD. (2016). Mitigating Droughts and Floods in Agriculture: Policy Lessons and Approaches (OECD Sudies on Water). Paris: OECD Publishing.
[68] MOTU economic and public policy research. (2018). Drought and climate change adaptation: Impacts and Projections.
[69] Westpac. (2018). Westpac NZ: Climate Change Impact Report.
[70] Frame, D, Rosier, S.,Carey-Smith, T., Harrington, L., Dean, S., Noy, I. (2018). Estimating financial costs of climate change in New Zealand - An estimate of climate change-related weather event costs. Report for the NZ Treasury.

harmful organisms in groundwater and surface water sources, and lead to a rise in mental health issues. [71]

Drought can have a significant effect on mental health, "particularly for those in rural areas who rely on rainwater for their livelihoods"[72] who may see their crops fail or need to buy in additional and likely expensive feed (if it is even available) to care for their animals.

The distress and trauma associated with natural disasters such as drought can affect entire communities[73] and according to the Royal Australian College of General Practitioners rural communities are likely to suffer additional disadvantages.

17: Urban water supply.

As we have seen in earlier paragraphs, droughts don't just impact on rural communities. Urban water supply can also face challenges if they don't have adequate storage capacity or alternate supplies.

Domestic water supply in New Zealand is primarily treated town supply piped from rivers, lakes, storage reservoirs and bores.[74] In drought conditions this supply could be threatened leading to significant risks:

"First and foremost, severe drought-related water supply which leads to water being cut off can lead to dehydration and death. Further, drought can increase the burden of water related diseases, and other diseases influenced by a lowered ability to keep conditions hygienic and sanitary".[75]

18: Climate Change will increase the prevalence of extreme weather events.

Season and area averaged metrics suggest that we are increasingly likely to experience drought like conditions similar to the summers of both 2013 and 2020 in the future.[76] A number of studies support this prediction of increased intensity, duration and spatial extent of droughts associated with higher temperatures, decreased precipitation, and increased evaporation.[77]

Over the last century the average annual temperature in New Zealand has risen by one degree Celsius and it is projected to keep climbing.[78] They are forecast to rise another 0.8 degrees by 2040 – and 1.6 degrees by 2090.[79] Of course, these are modelled averages, but the message is clear none the less.

[71] EHINZ. (2020). Drought conditions in NZ over time.
[72] Ibid.
[73] Farberow NL. Mental health aspects of disaster in smaller communities. Am J Soc Psychiatry 1985;4:43–55.
[74] MOTU economic and public policy research. (2018). Drought and climate change adaptation: Impacts and Projections.
[75] Bennett, H., Jones, R., Keating, G., Woodward, A., Hales, S., & Metcalfe, S. (2014). Health and equity impacts of climate change in Aotearoa-New Zealand, and health gains from climate action. The New Zealand Medical Journal (Online), 127(1406), page 16.
[76] Harrington, L. J., Gibson, P. B., Dean, S. M., Mitchell, D., Rosier, S. M., & Frame, D. J. (2016). Investigating event-specific drought attribution using self-organizing maps. Journal of Geophysical Research: Atmospheres, 121(21).
[77] MOTU economic and public policy research. (2018). Drought and climate change adaptation: Impacts and Projections.
[78] Ministry for the Environment 2018. Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment, 2nd Edition. Wellington: Ministry for the Environment.
[79] Ibid.

According to the Ministry for the Environment "drought frequency and intensity is projected to increase across most of New Zealand as a result of climate change. Regions that are particularly at risk are in the northern and eastern North Island and the eastern South Island"[80]

We cannot hide from the impacts of climate change, and as the global temperature rises so will increase the risk of agricultural drought. [81] Equally, so too will the risk of flood. Climate change will likely lead to an increase in both the frequency and intensity of extreme rainfall.

This is because a warmer climate increases the water-holding capacity of the air, and therefore rainfall is like to be more intense. MfE reports suggest "the expected percentage increase in extreme rainfall is around 8 per cent per degree Celsius of temperature increase". [82] On those numbers, assuming a 1 to 2°C temperature rise by the end of the century, we can anticipate that the intensity of extreme rainfall in the future might increase by 8 to 16 per cent.

Projections show spring/winter rainfall increasing in the west of the country but decreasing in the east and north. Summer will likely bring wetter conditions in the east and drier conditions in the west than what we currently experience.[83]

It should be noted that some of these changes are not 'coming' – they have been with us for some time. Over the last 50 years there have been observable changes to our weather patterns.

For example, New Plymouth, Wellington, and Whangarei have all seen increases in their winter rainfall. Conversely, Dunedin and Kerikeri have experienced decreased summer rain.[84]

We have also seen changes to both soil moisture and ice volumes. Many of our soils have become progressively drier and the volume of water held in our glaciers has reduced by 25%.[85]

[80] Ibid..
[81] Collins, M., R. Knutti, J. Arblaster, J.-L. Dufresne, T. Fichefet, P. Friedlingstein, X. Gao, W.J. Gutowski, T. Johns, G. Krinner, M. Shongwe, C. Tebaldi, A.J. Weaver and M. Wehner, 2013: Long-term Climate Change: Projections, Commitments and Irreversibility. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[82] Ministry for the Environment. (2010). Preparing for future flooding: A guide for local government in New Zealand.
[83] Ministry for the Environment. (2016). Climate change projections for New Zealand: atmosphere projections based on simulations undertaken for the IPCC 5th assessment.
[84]Ministry for the Environment & Stats NZ. (2017). New Zealand's Environmental Reporting Series: Our atmosphere and climate 2017 (Ministry for the Environment and Statistics New Zealand report).
[85] Ibid.

Fox Glacier is melting at an alarming rate. Photo credit: IAIN MCGREGOR/STUFF

These changes produce two seemingly contradictory effects: more intense downpours, leading to more floods, yet longer dry periods between rain events, leading to more drought. In my view, this only strengthens the case for capturing the water while we can and storing it for when we need it.

Although water storage may not be able to prevent meteorological drought from occurring, capturing water when it is available and storing it for when it is not will certainly help blunt the impacts and prevent us from feeling the agricultural, hydrological, environmental, economic, and social impacts.

19: Electricity generation.

Another significant opportunity that increased water storage presents for New Zealand is the opportunity to increase our levels of renewable electricity generation through hydro.

New Zealand's share of renewable electricity generation is there third highest in the OECD, but our levels fluctuate year-to-year, largely due to hydro-generation. [86] Our percentage of renewables dropped from 84% in 2018 to 82.4% in 2019 due to low inflows – with the gap between supply and demand being met by non-renewable sources like coal and gas.[87]

In order to drive down emissions the current Labour Government has announced an ambitious goal of having 100 percent renewable electricity generation by 2030.[88] This goal is ambitious for two reasons: Firstly, because that is a significant increase from our current levels and secondly, because demand for electricity is likely to increase substantially as we electrify other parts of our economy such as transport and industrial heat.

[86] Ministry of Business, Innovation & Employment. (2019). Energy in New Zealand 2020.
[87] Ibid.
[88] Ardern, Jacinda. (2020). 100% renewable electricity generation by 2030. New Zealand Labour Party.

This is a significant opportunity for increased water storage. While more than half of our electricity current comes from hydro generation[89] we still have significant untapped potential. While some of our larger hydro damns have considerable storage capacity e.g., Benmore, Clyde, and Manapouri, we actually have a relatively small storage capacity of 4TWh vs annual inflows of 24TWh.[90]

By increasing our hydroelectricity capacity, we could support New Zealand's transition off fossil fuels and towards a low emissions economy.

Although there has been some variability in terms of our hydro generation's reliability due to fluctuating water levels in the South Island and reduced river flow in times of drought for run-of-river schemes like those in the Waikato, these risks may be able to be mitigated.

The increased prevalence of drought may be offset by increased instances of extreme rain and rapidly melting ice glaciers increasing winter flows to our hydropower lakes. The net effect would likely flatten the annual cycles of flows and generation capacity.[91]

It should also be noted that hydroelectricity is not the only renewable energy source in New Zealand that is highly dependent on water supply. Over 17% of our electricity is generated by non-consumptive thermal power stations that rely on water as a coolant that is then discharged back into our waterways.[92]

20: Opportunities for land use change.

Land use flexibility and land use change have underpinned the success of New Zealand's primary sector since its inception. It may not always be overtly visible in a broad pattern, but it is always occurring, often at the regional level, as new and more profitable ways to farm arise whether they be driven by markets, climate, water, or any other factor.[93]

Recent examples include the largescale conversion from dry stock farming in Canterbury and Southland during the early 2000's or the continued conversation to horticulture e.g., kiwifruit and avocados in the Bay of Plenty, or the prevalence of grapes in Marlborough. All of these things happened because an individual saw an opportunity and acted on it.

Land will always over time move to its best use as determined by the potential productivity, and therefore the potential profitability.[94] On this basis, "landowners looking to maximise their returns, or profit, will select land use according to the quality of their land, with the best quality land being

[89] EECA. (2016). Energy use in New Zealand: Renewable energy resources - Hydroelectricity. Energy Efficiency and Conservation Authority: Te Tari Tiaki Pūngao.

[90] MOTU economic and public policy research. (2018). Drought and climate change adaptation: Impacts and Projections.

[91] Renwick, J., Mladenov, P., Purdie, J., McKerchar, A., & Jamieson, D. (2010). The effects of climate variability and change upon renewable electricity in New Zealand. In Climate change adaptation in New Zealand: Future scenarios and some sectoral perspectives (pp. 70–81).

[92] EECA. (2016). Energy use in New Zealand: Renewable energy resources - Hydroelectricity. Energy Efficiency and Conservation Authority: Te Tari Tiaki Pūngao.

[93] Thorrold, B.S. 2010. The future landscape of New Zealand Agriculture. Proceedings of the New Zealand Grassland Association. 72: LXIII-LXVI.

[94] Anastasiadis, S., Kerr, S., Zhang, W., Allan, C., & Power, W. (2014). Land Use in Rural New Zealand: Spatial Land Use, Land use Change, and Model Validation. Motu Working Paper 14-07. Motu Economic and Public Policy Research. Wellington.

used for the most intensive, profit generating use, and the poorest quality land being less productive".[95]

21: Factors that drive land use change.

There are a number of factors that drive land use change, including but not limited to:

Biophysical factors: Soil type, topography, climate, and availability of water.

Economic factors: comparative profit, proximity to the market, access to labour, and access to infrastructure e.g., irrigation

Societal factors: Regulation, social license, changing diets.

22: Current pressures.

Pastoral farmers are increasingly coming under pressure from both regulators and society in general to reduce their environmental footprint. The Zero Carbon Act will require a 10% cut to biogenic methane levels by 2030, and between 24 and 47% by 2050.[96] Similarly, the new National Policy Statement for Freshwater Management has put in place tough new regulations including national bottom lines of 2.4 milligrams of nitrate-nitrogen per litre.[97]

These externalities relating to greenhouse gases and water are rapidly starting to be addressed by Government, driven by public expectation, and as a result they are being priced into land use decisions as one of many 'market' factors to be considered.[98]

Both of these environmental regulatory drivers are likely to drive land use change within New Zealand.[99] Recently modelling suggests there are limited opportunities to change systems on farm to reduce emissions[100] raising the likelihood that land use change to both forestry and horticulture will emerge as a mitigation strategy. Although the underlying action is 'improving environmental outcomes' the true driver will be the economic cost of non-compliance.[101]

The Independent Climate Change Commission's recently released draft advice to Government on setting emissions budgets supports this assessment with their modelled scenario including future land use change from livestock agriculture into horticulture and exotic forestry as a mechanism to reduce methane emissions.[102]

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[95] Anastasiadis, S., Kerr, S., Zhang, W., Allan, C., & Power, W. (2014). Land Use in Rural New Zealand: Spatial Land Use, Land use Change, and Model Validation. Motu Working Paper 14-07. Motu Economic and Public Policy Research. Wellington.

[96] Climate Change Response (Zero Carbon) Amendment Act 2019, S5Q(1)(b).

[97] National Policy Statement for Freshwater Management 2020, page 45.

[98] AgFirst. (2017). Analysis of drivers and barriers to land use change. (A report prepared for the Ministry of Primary Industries), page 38.

[99] Ibid at page 34.

[100] Reisinger, A., Clark, H., Journeaux, P., Clark, D., & Lambert, G. 2017. On-farm options to reduce agricultural GHG emissions in New Zealand. NZAGRC report to the Biological Emissions Reference Group.

[101] AgFirst. (2017). Analysis of drivers and barriers to land use change. (A report prepared for the Ministry of Primary Industries), page page 37.

[102] Climate Change Commission. (2021). 2021 Draft Advice for Consultation, page 174.

They specifically mooted the idea of reducing dairy, sheep and beef numbers by around 15% from 2018 levels by 2030 [103] and transforming a small amount of dairy land into horticulture, at a rate of 2,000 hectares per year from 2025.[104]

Although conversion from dairy to horticulture could reduce biogenic emissions per hectare, the Commission did specifically note that this could lead to other environmental challenges such as deteriorating water quality as a result of increased use of fertiliser, and consequential nitrogen and phosphorus losses.[105] Of course, the nutrient losses would vary depending on the crop, location, soil, weather and how the land is managed.[106]

It should be noted that this report is the Commissions advice to Government and is not Government policy. If the Government chooses to implement the advice, they will need a policy mechanism to drive it.

23: Increased water storage as an enabler.

In offering their advice the Commission expressly recognised that increasing the area of horticulture in New Zealand would significantly increase demand of water - particularly in a warming global climate. As such, any increased need for water would need to be weighed up when considering converting to horticulture as a climate action.[107]

The Commission knew that the availability or otherwise of water for irrigation could be the major driver, or barrier, for land use change. This is because many of the other drivers, such as return per hectare, are already in favour of conversion.

Figure 7:

EBIT per hectare from differing land uses.

	2013	2014	2015	2016	Average
Pipfruit	$13,973	$14,850	$18,530	$21,160	$17,128
Viticulture	$10,440	$13,360	$7,513	$16,015	$11,832
Kiwifruit	$28,859	$27,058	$29,222	$36,347	$30,372
Dairy	$2,661	$4,007	$2,483	$957	$2,527
Sheep and Beef	$126	$181	$175	$138	$155

Source: MPI 2017, DairyNZ 2017, Beef + Lamb NZ 2017

Of course, not everyone can convert to horticulture and nor should they, but for some landowners who have the right climate, soil, topography, and access to the capital required to convert – water may be the last ingredient needed to unlock greater profits. This all comes back to the principle discussed earlier in the paper that over time, land will always migrate to its best use.

24: Highly productive land.

Much has been made in recent years regarding 'highly productive soils', or rather, highly productive land (rather than 'soil') given its focus is on the capability of 'land' for a certain use. There is a

[103] Ibid.
[104] Ibid at page 65.
[105] Ibid at page 101.
[106] Ibid.
[107] Ibid.

general acceptance that there is a need to protect this highly productive land for future primary production.

The reference to 'land' and not 'soil' is in recognition of the fact "there are other factors in addition to soil that determine the productive capacity of land for primary production. These include factors like climatic conditions and water availability, as well as proximity to transport infrastructure and labour". [108]

The issue has largely been brought to a boil as a direct result of the immense pressure coming on local growers in areas like Pukekohe, south of Auckland, as a result of increased and rapid urban expansion. [109]

Pukekohe's soil and climate conditions are well suited to food production and are located conveniently close to Auckland, our largest population centre, for transportation. Unfortunately, it is this same close proximity to Auckland city that is threatening those soils.

Auckland's population is forecast to grow from 1.7 million people today to 2 million people in the next 30 years.[110] The city will need land available for development to house this growing population, but it will also need productive lands to be well utilized in order to sustain them. We also have other competing pressures like our national goal of doubling our agricultural exports by 2025.[111]

25: A strategic opportunity?

Increased water storage in the Northland region may present a strategic opportunity to relieve some of the pressure Pukekohe is facing, reduce risks associated with extreme weather events or biosecurity incursions, and enable another large food producing area in close proximity to Auckland.

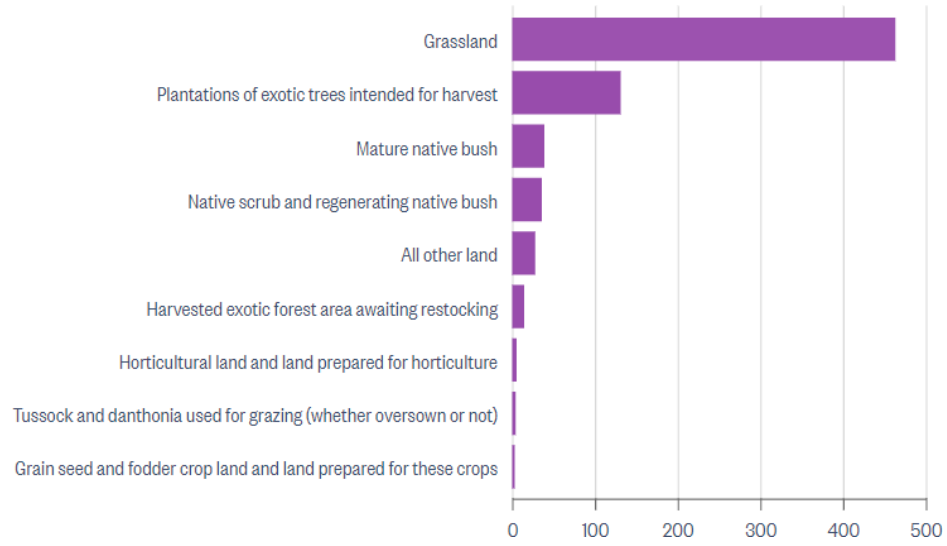
Northland does have some high productive volcanic soils that are currently underutilized such as Papakauri Silt Loam and Waimate North Heavy Silt Loam. These soils can be found in the Whangarei, Kaikohe and Kerikeri districts.[112]

Although these soils may not be to the same standard as those in Pukekohe, but they are still high-quality soils none the less. They are currently largely devoted to pastoral farming; however, they are also highly suited to vegetable cropping and horticulture[113] provided there is adequate supply of water.

As it currently stands Northland's primary sector is largely dominated by both pastoral farming and forestry.

[108] Ministry for Primary Industries. (2019). Valuing highly productive land.
[109] Ibid.
[110] Auckland Council. (2018). Soil Information Inventory: Patumahoe and related soils.
[111] Ibid.
[112] Molloy, Les. (1988). Soils in the New Zealand landscape: the living mantle. Wellington: Mallison Rendel in assoc. with the New Zealand Society of Soil Science.
[113] Ibid.

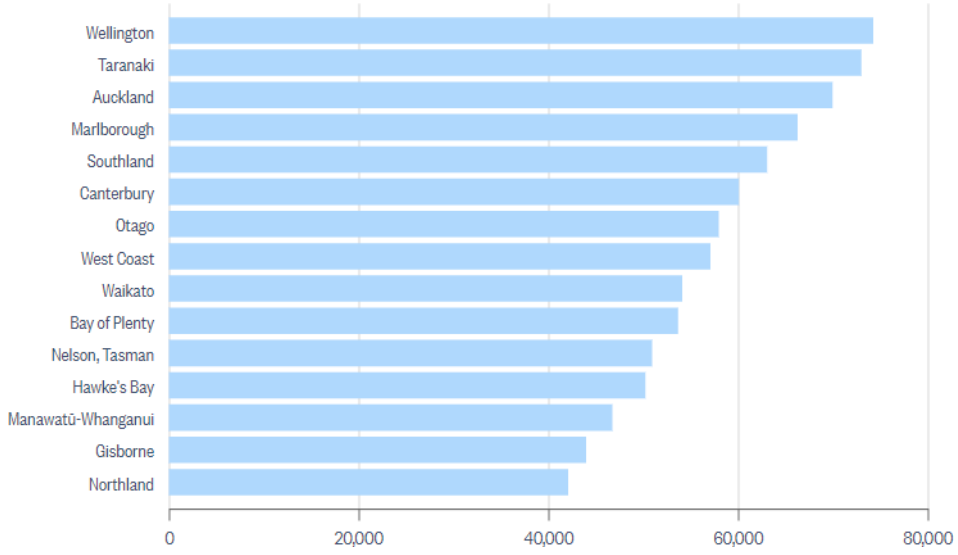
Figure 8:



Land use of farms in the Northland Region, New Zealand
By type, thousand hectares.
Source: Stats NZ[114]

Despite these good soils and a warm climate, they have not been able to unlock their full potential. As a result, they are one of New Zealand's most economically deprived regions in terms of GDP per capita and median annual household income.

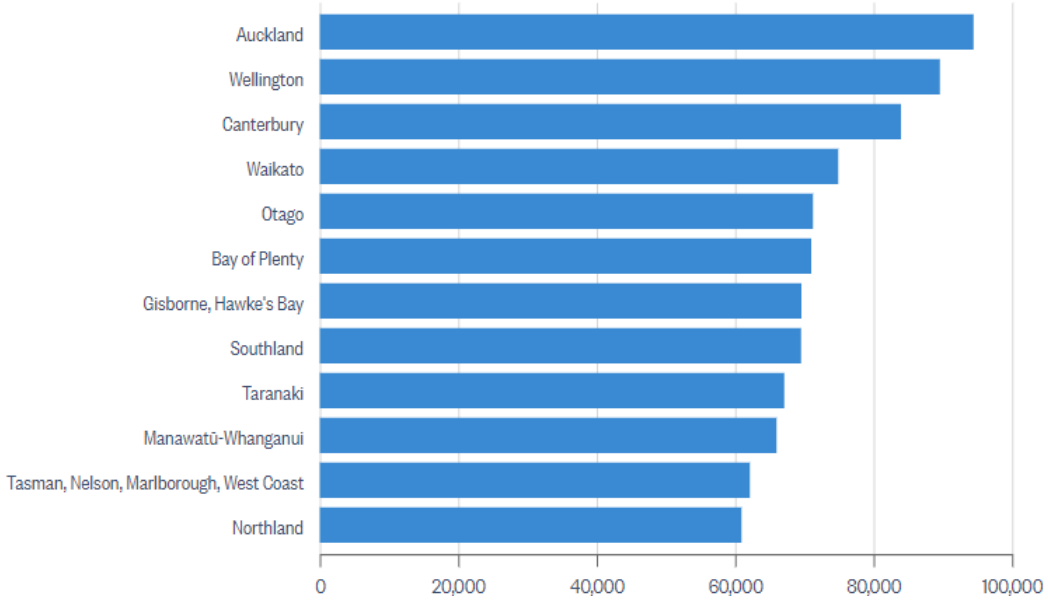
Figure 9:



Gross Domestic Product per capita of New Zealand regions
Source: Stats NZ[115]

[114] Stats NZ. (2020). Household income and housing-cost statistics: Year ended June 2019.
[115] Stats NZ. (2020). Regional gross domestic product: Year ended March 2019.

Figure 10:



Median annual household gross income in New Zealand
Source: Stats NZ[116]

In Kerikeri they have recognised the potential of this soil for the horticultural industry with over 1000 ha now planted in citrus, kiwifruit, and tamarillos.[117] They have rectified the acute shortage of soil moisture during northland's dry summer periods through increased water storage and investment in an irrigation scheme.[118]

So, what's stopping Whangarei from becoming the next Tauranga or Kaikohe the next Kerikeri? At face value it would appear the only difference is reliable access to water.

26: A lack of strategy.

As we have seen in the chapters above, New Zealand has significant untapped potential that could be unleashed if only we could increase our levels of water storage for productive, efficient, sustainable, and strategic use – yet we have no overarching strategy leading and guiding our decision making to help us achieve this.

As the impacts of climate change intensify, we are going to need to radically transform our national economy. This will likely require a level of land use change, diversification of our primary sector, and potentially a rapid shift from 'volume' to 'value'.

The challenge is that the transformation required is at a national level, but our water storage planning and investment happens at a regional and local level. This piecemeal, project-based approach to water storage is not setting NZ up for success.

[116] Stats NZ. (2020). Household income and housing-cost statistics: Year ended June 2019.
[117] Molloy, Les. (1988). Soils in the New Zealand landscape: the living mantle. Wellington: Mallison Rendel in assoc. with the New Zealand Society of Soil Science at page 87.
[118] Ibid.

Often the Councils involved are small and ill-equipped to deal with complex water storage projects. This can lead to both overinvestment or underinvestment (both of which are negative outcomes – or even worse, projects stall.

There is no overarching strategy or central support that helps pull everything together for the benefit of NZ Inc with leadership and direction. Previously this role may have been filled, to a limited extent, by Crown Irrigation Investments Limited (CIIL) however in 2018 the Government decided to wind them down. [119]

Our primary sector has rightly identified the risk a lack of coordinated long-term strategy presents with IrrigationNZ calling for "a national water strategy that guides the future of water management and investment across Aotearoa New Zealand".[120]

They are of the view that a bi-partisan, independent water commission could play a leadership role in decision-making and funding allocation at the central, regional, and local levels.

DairyNZ has called for the Government to consider a national water storage strategy "to help increase reliability of water supply in times of drought, to enable land-use flexibility and farming within environmental limits, and to help regions like Northland unlock their full economic potential."[121]

Similar calls for greater strategic investment in water storage have been made by the likes of HortNZ and Federated Farmers. [122]

27: Political uncertainty.

Political uncertainty is also a significant barrier for investment in water storage. These schemes are significant investments with multimillion dollar price tags and those who are putting up the cash want to know they will be able to reap the rewards.

The most recent example of political uncertainty is the Government's decision to wind down funding for large-scale irrigation through Crown Irrigation Investments Limited (CIIL)[123] which was done in line with their Coalition Agreement with New Zealand First and the Confidence & Supply Agreement with the Green Party.

The Confidence & Supply Agreement with the Green Party demanded the Government wind down all Government support for irrigation[124] however the Coalition Agreement with New Zealand First required the Government to "honour existing Crown Irrigation investment commitments".[125]

The end result was that all existing CIIL commitments for development contracts were honoured to the close of the current phase of each contract due to their advanced stages, however a number of

[119] Robertson, Grant. (2018). Government to wind down irrigation funding while honouring existing commitments.
[120] Irrigation NZ. (2020). Election Manifesto.
[121] Burger, David. (2020). DairyNZ welcomes regional water storage announcement.
[122] Federated Farmers. (2020). Freshwater report underlines serious need for water storage investment.
[123] Robertson, Grant. (2018). Government to wind down irrigation funding while honouring existing commitments.
[124] New Zealand Labour Party & Green Party of Aotearoa New Zealand. (2017). Confidence & Supply agreement.
[125] New Zealand Labour Party and New Zealand First. (2017). Coalition agreement.

other projects who had invested substantial money in feasibility studies and other preparatory work will stopped in their tracks.

28: Financial barriers.

One of the largest barriers for investment in water storage is funding.

The most common ownership model is a co-operative lead by landowners where 'ownership' is attached to the value of the farmer or growers land – and is transferred with the land upon sale.

The main driver is the provision of reliable water supply at the lowest possible cost to increase production, and therefore farm profit. Although this model may 'get the job done' it doesn't really incentivise the efficient use of water or timely maintenance.

These are intergenerational assets with the benefit is spread over decades, if not longer, but the cost is often front-loaded. Large scale irrigation schemes can cost upward of $300 million. This is a huge barrier to overcome and is largely the issue CIIL was set up to help overcome.

By removing Government support for large scale irrigation projects, a clear message was sent that farmers are the largest beneficiaries of water storage and therefore they should pay the cost – but as we have seen throughout this report, it's not just the farmer who benefits. It is entire communities.

It is frustrating that the need for increased water storage investment is so critical going forward, but the support has just been removed. Without central support large scale projects are going to be few and far between.

29: Fear of further dairy intensification.

The final challenge I would like to touch on is a fear of further dairy intensification that is primarily driven by our national experience in the early 2000's.

At the turn of the century our dairy sector experienced a period of rapid growth was fuelled by a number of factors like the formation of Fonterra, a Free Trade Agreement being signed with China, and increased demand for milk and dairy products globally. [126]

Between 1999 and 2014 we saw significant land use change from dry stock and forestry to dairy. "Milk production nearly doubled, the area of dairy farmland increased by 74%, and the total number of dairy cows by 65%".[127]

As land conversions continued, the dairy sector continued to spread geographically across the country. There was extensive growth in both Canterbury and Southland. In many parts of the country this growth was enabled by irrigation.

Although this expansion brought significant prosperity to New Zealand, it also brought some environmental challenges in terms of nitrates and methane emissions. Technology such as centre pivot irrigation also quite visibly changed the landscape. It was around this time that Fish & Game launched their 'dirty dairy' campaign.

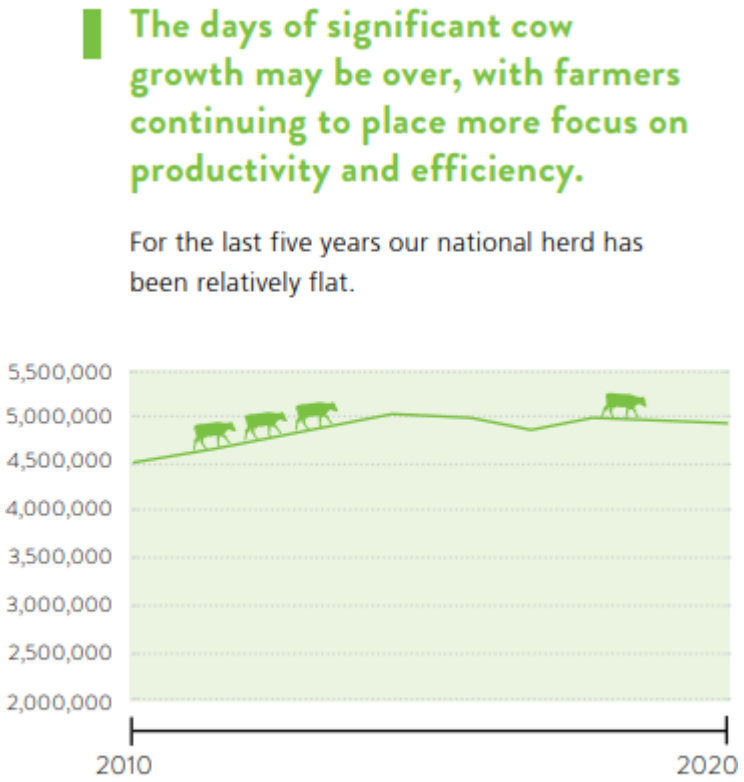
Although some New Zealanders may be fearful of further intensification, their concern is likely misplaced. Unless new technology becomes available that significantly reduces both the methane

[126] Global Rural. (2019). Deconstructing the New Zealand Dairy Boom.
[127] Ibid.

emissions and nitrogen loss from the dairy sector their growth will likely be naturally constrained existing regulation and environmental limits.

In addition to this, current trends would suggest our national dairy herd has been relatively flat over the last five years.

Figure 11:



Source: NZ Dairy Statistics 2018-19, DairyNZ and LIC

Although DairyNZ have recently called for increased water storage they have been quite clear that they don't view water storage as a means to further intensification in already over-allocated catchments, but rather as a way for existing farmers to ensure they can access it when they need it.[128]

[128] Burger, David. (2020). DairyNZ welcomes regional water storage announcement.

30: Recommendations.

1) The Government should establish an Independent Water Storage Commission, similar to the Independent Climate Change Commission, to take the politics out of water security and provide long-term certainty.

2) New Zealand should urgently set a national water storage strategy to help guide and coordinate investment for the future.

3) Financial support for large scale irrigation projects should be reinstated – whether that is through Crown Irrigation Investments Ltd, an Independent Water Storage Commission, or another similar body.

4) Although the way we slice the pie through allocation is important, we shouldn't be afraid to discuss growing the pie.

5) As a country we need to make resolving the issue of Māori rights and interests in water a priority.

6) Water storage investment for the Northland region needs to be prioritised to unlock their full economic potential. In my view it is the region of the greatest opportunity and need.

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