Relevance of the One World, One Health framework to farming in Aotearoa New Zealand – A perspective piece.

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‘Think piece’ on Regenerative Agriculture in Aotearoa New Zealand: project overview and statement of purpose

Gwen Grelet & Sam Lang

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Find the full project overview, white paper and topic reports at ourlandandwater.nz/regenag and www.landcareresearch.co.nz/publications/regenag

This report is one of a series of topic reports written as part of a ‘think piece’ project on Regenerative Agriculture (RA) in Aotearoa New Zealand. This think piece aims to provide a framework that can be used to develop a scientific evidence base and research questions specific to RA. It is the result of a large collaborative effort across the New Zealand agri-food system over the course of 6 months in 2020 that included representatives of the research community, farming industry bodies, farmers and RA practitioners, consultants, governmental organisations, and the social/environmental entrepreneurial sector.

The think piece outputs included this series of topic reports and a white paper providing a high-level summary of the context and main outcomes from each topic report. All topic reports have been peer-reviewed by at least one named topic expert and the relevant research portfolio leader within MWLR.

Foreword from the project leads

Regenerative Agriculture (RA) is emerging as a grassroot-led movement that extends far beyond the farmgate. Underpinning the movement is a vision of agriculture that regenerates the natural world while producing ‘nutrient-dense’ food and providing farmers with good livelihoods. There are a growing number of farmers, NGOs, governmental institutions, and big corporations backing RA as a solution to many of the systemic challenges faced by humanity right now, including climate change, food system disfunctions, biodiversity loss, human health (to name a few). It is a movement behind which a momentum of change is building at all levels of the food supply and value chain. And so now is an exciting time for scientists and practitioners to work together towards a better understanding of RA, and what benefits may or not arise from RA adoption in NZ.

RA’s definitions are fluid and numerous – and vary depending on places and cultures. This lack of crystal-clear definition makes it challenging as a study subject, as it is not a ‘thing’ that can be put in a clearly defined experimental box nor be dissected methodically. In a way, regenerative agriculture calls for a more prominent acknowledgement of the diversity and creativity that is characteristic of farming – a call for reclaiming farming as an art and a verb, constantly evolving and adapting, based on a multitude of theoretical and practical expertise.

RA research can similarly enact itself as a braided river of interlinked disciplines and knowledge types, spanning all aspects of health (planet, people, and economy) – where curiosity and open-mindedness prevail. The intent for this think piece was to explore and demonstrate what this braided river could look like in the context of a short-term (6 months) research project. It is with this intent that Sam Lang and Gwen Grelet have initially approached the many collaborators that contributed to this series of topic reports – for all are bringing their unique piece of knowledge, expertise, values and worldviews or perspectives on the topic of RA.

How was the work stream of this think piece organised?

The project's structure was jointly designed by a project steering committee comprised of the two project leads (Dr Gwen Grelet[1] and Sam Lang[2]); a representative of the New Zealand Ministry for Primary Industries (Sustainable Food and Fibre Futures lead, Jeremy Pos); OLW's Director (Dr Ken Taylor and then Dr Jenny Webster-Brown), chief scientist (Prof Rich McDowell) and Kaihāpai Māori (Naomi Aporo); NEXT's environmental director (Jan Hania); and MWLR's General Manager Science and knowledge translation (Graham Sevicke-Jones). OLW's science theme leader for the programme 'Incentives for change' (Dr Bill Kaye-Blake) oversaw the project from start to completion.

The work stream was modular and essentially inspired from theories underpinning agent-based modelling (Gilbert 2008), which have been developed to study coupled human and nature systems, by which the actions and interactions of multiple actors within a complex system are implicitly recognised as being autonomous, characterised by unique traits (e.g. methodological approaches, world views, values, goals, etc.) while interacting with each other through prescribed rules (An 2012).

Multiple working groups were formed, each deliberately including a single type of actor (e.g. researchers and technical experts only or regenerative practitioners only) or as wide a variety of actors as possible (e.g. representatives of multiple professions within an agricultural sector). The groups were tasked with making specific contributions to the think piece (see Fig. 1). While the tasks performed by each group were prescribed by the project lead researchers, each group had a high level of autonomy in the manner it chose to assemble, operate, and deliver its contribution to the think piece. Typically, the groups deployed methods such as literature and website reviews, online focus groups, online workshops, thematic analyses, and iterative feedback between groups as time permitted (given the short duration of the project).

[1] Senior scientist at MWLR, and appointed as an un-paid member of Quorum Sense board of governors and part-time seconded to Toha Foundry while the think piece was being completed

[2] Sheep & beef farmer, independent social researcher, and project extension manager for Quorum Sense

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Alison Dewes[1], Paul Tapsell[2]

[1]Tipu Whenua, [2]Takarangi Research

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Reviewed by:

Dr Mike Joy
Victoria University of Wellington

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1. Introduction to One Health

In New Zealand we have a strong and growing alliance between professionals in medical, veterinary, environmental, and Te Tiriti-aligned health, working in a spirit of One Health collaboration. This has achieved success in control of food-borne pathogens and recently with COVID 19 collaborative thought leadership resulted in an agile and rapid response policy to protect NZ from a virulent pandemic.

We must holistically understand and account for the externalities from human activity in our policy design while balancing NZ's desire to maintain a high standard of living (capitalism), but we must also switch to a risk-based preventative model to protect our ecosystem and our connected life and lives.

Our leadership in this post-pandemic world must understand that the origins of such pandemics and degradation of the environment has a shared cause – human activity. Intensification and expansion of agriculture and land use change are bringing people and animals and the microbes they carry into overlapping proximity.

A One Health approach reflecting the interconnection of our ecosystem, human health, animal health, and other factors including biodiversity and environment as a source of life-giving resource enables this risk to be assessed and appropriate responses actioned.

This approach makes sense in New Zealand, given the country's relatively isolated island ecosystem is vulnerable to introduced pest and pathogens, economic dependency on agriculture, and the physical environment, well-connected scientific community, and an existing Indigenous Māori world view and knowledge system that emphasises holism and interconnectivity between humans, animals, and the environment.

Previous agricultural policy has not taken such a holistic view and has resulted in agricultural intensification facilitated by permissive lending and resource allocation regimes with industry advocacy to increase output and resource exploitation (water, soils, animals, and people). Our eco-systems are now more fragile and require novel leadership on how to adapt with agility to a changing world of increasing disease threat, new regulations, and amplified scrutiny from public and trading partners.

We need future farm systems that meet these needs to protect and enhance nature-based services inside ecosystem and human health limits. Ethically driven agricultural systems will have to be motivated by education, and cross-agency support to show stewardship. This must be underpinned by evidence-based One Health research that informs, guides, and protects public health and well-being, our natural world, and the life-support capacity it provides.

1.1. What is One Health?

'One Health' is the collaborative effort of multiple health-science professionals who bring together their related disciplines and institutions to attain optimal health for people, domestic animals, wildlife, plants, and our environment. One Health is endorsed by the WHO

and is being increasingly recognised as the way forward to resolve many of the pressing problems that face humanity. These problems include zoonotic diseases, antimicrobial resistance (AMR), diseases arising from food and waterborne pathogens, and the health of the environment. In New Zealand we have a strong and growing alliance between professionals in medical, veterinary, environmental, and whenua health contexts who are working in a spirit of One Health collaboration.

Despite success in the control of food-borne pathogens and the recent COVID 19 response, there is a pressing need to prioritise the protection of natural ecosystems and receiving water bodies, to enhance resilience, biodiversity, and deep cultural engagements, ultimately protecting public health and well-being from the threats listed above.

To address this need requires new collaborative research, and more effective integration of current knowledge to better inform decisions that affect human, animal, and ecosystem health (French et al. 2017).

1.2. What New Zealand can learn from recent pandemics

Our health system has, for the most part, responded well to COVID-19. Our research institutions and universities have engaged quickly and effectively to provide scientific support for the public health response.

Yet we can, and must, do better. Our expertise and systems are not confluent. They struggle to provide vital, timely, coordinated responses to our 21st century challenges. For example, there is little or no representation of public health on agricultural advisory panels. A recent example of this lack of representation is the Freshwater Leaders Group, the Kahui Wai Māori and associated Science Group informing the National Policy Statement for Freshwater Management and Resource Management Act changes (2019/20), despite the fact that how we manage our land directly affects our freshwater, and ultimately the health of the public who depend on it. We urgently need to engage cross-silo thinking in the policy design phase.

Generally, our scientists work independently, despite obvious overlapping interests and skill sets. The provision of economic support to encourage collaborative research might well encourage a shift to new thinking. For example, the tackling of infectious diseases is particularly important. The development of formalised cross-research teams across human, animal, and environmental health silos would ensure early communication of potential threats and opportunities, focused through a One Health lens (Murdoch 2020).

Recent pandemics have shown us that further epidemic and pandemic challenges are inevitable in our globalised world, for example seventy percent of emergent disease are zoonotic and there are an estimated 1.7 million undiscovered viruses in mammalian and avian hosts (IPBES 2020). Climate change has a major impact on pathogen-harbouring animal habitats (e.g. mammalian bats) and the biodiversity decline that results in the migration of animals to human-dominated habitats. These all represent risks to human health. In our New Zealand context this is easily observable in the urban population of long-tailed bats in Hamilton and other regions (Ray 2018). We must begin to assess and

acknowledge these risks and act preventively to find effective methods of mitigation to protect our human health.

A cohesive and holistic approach, from land to water to public health, makes sense in New Zealand. We are an island nation, vulnerable to introduced infectious diseases and economically dependent on agriculture and the physical environment. But we are also home to an existing Indigenous Māori world view. This genealogically grounded knowledge system is unique to New Zealand, providing an additional window by which to interpret the interconnectivity between environment, animals, and people.

1.3. Environmental and public health impacts of food production

Recent zoonotic disease (e.g. Swine Flu, Avian Influenza, and, potentially, COVID) shows how we have blurred the boundaries of safety, and health in our quest for cheaper, more accessible proteins.

Our whenua – natural landscapes, waterways, and biological systems – do not behave in a linear fashion; they tolerate stress and assimilate toxins for long periods, then degrade exponentially. In 2020, our water is increasingly stressed due to a combined legacy of over-extraction (water), and increased nutrient, sediment, and pathogen loads, resulting in reduced health-giving (ecosystem servicing) capacity. We have significant issues with degrading water quality and estuarine systems from sediment and nutrient loads. Practices such as intensive winter grazing and intense stocking rates create soil compaction and loss of macroporosity, which contribute to the loss of topsoil and reduction of the assimilative capacity of soils. The time for institutional monitoring and observation of health decline is over. It is time for triage. The patient – our imagined clean green, whenua-cloaked nation – will continue to lose legitimacy if we do not make a major and significant change from the old economic structures, agency control, and industrial advocacy of the previous 3 decades.

We need to free our farming systems from a cross-generational agenda of growth without limits, amass and include collective knowledge and wisdom beyond western science from a space of visionary leadership, and restore the balance that nurtures ecologically inclusive protection and replenishment of the soils, waterways, and biodiversity of our fragile islands, to one interconnected system – One World, One Health, One Humanity (Tapsell & Dewes 2019).

1.4. Declaration of a Climate Emergency

If the impetus of zoonotic pandemics is not enough to initiate a serious rethink, in November 2020 NZ announced a Climate Emergency. Climate Change has serious flow-on impacts on public health that will need to be planned:

- The effects of climate change will not be spread evenly across the population, rather they will exacerbate existing socioeconomic and ethnic health inequalities. Well-designed policies to reduce global greenhouse gas emissions will not only limit climate change and reduce the associated risks to human health but have the

potential to improve population health and reduce health inequalities (Royal Society 2017).

- Water shortage through drought, reduced rainfall, increased water takes, and altered rainfall pattern is likely to result from climate change. Additional cumulative effects will include, for example, algal bloom from nutrient-rich run off, which will be amplified as droughts and water shortages eventuate, making these contaminants become more concentrated in the receiving water bodies.
- Exposure to waterborne disease (fresh and marine waters) caused by bacteria, viruses, and protozoa such as *Giardia* and *Cryptosporidium* is expected to increase from climate change. Changing weather patterns, including more extreme rainfall events, flooding, and higher temperatures, are likely to interact with agricultural run-off, and affect the incidence of diseases transmitted through infectious drinking and recreational water.

Contaminated drinking water was responsible for the Campylobacter outbreak in Havelock North in August 2016. Other potential zoonoses commonly associated with agriculture include Salmonella and E. coli, where concentrations in streams can increase significantly in the summer months, following heavy rainfall. The bacteria *Leptospira*, which is introduced into water from the urine of infected animals, can also cause increased human illness (ranging from nausea to renal failure) following increased temperatures and flooding events.

Other anticipated outcomes of climate change include change in habitat of animals and wildlife, and secondly pests and pathogens carried by animals including parasites. These risks must be assessed in terms of potential to negatively impact human health.

Again, we must think holistically about the lifecycle and movement of water. The marine bacteria *Vibrio* can cause infected wounds, diarrhoea or septicaemia if it contaminates sea food. Vibrio growth rates are highly responsive to rising sea surface temperatures, particularly in coastal waters.

Although detailed research indicates the impacts climate change is having on NZ, we cannot stop monitoring. NZ already has relatively high rates of waterborne illness compared with other high-income countries, estimated at between 18,000 and 34,000 gastroenteritis cases annually (Royal Society Te Apārangi 2017). We cannot afford to leave this unchecked.

2. Three decades of policy-enhanced intensification

We must think more holistically about environmental policy to ensure an optimised outcome without unintended consequences of continuing to drive the wrong behaviour.

In NZ we have seen a variety of policies aimed at trying to motivate changes to farming practice to reduce the agricultural footprint on our whenua and improve the health of receiving water bodies: springs, wetlands, aquifers, rivers, estuaries, and oceans, along with protection and enhancement of our biodiversity.

Unfortunately, the policies and agencies responsible for the past 3 decades of significant agricultural intensification – even when assessed narrowly on the impact on the environment – have failed and diminished the life support capacity of our whenua/natural landscape (Brown 2019).

Current policy frameworks are a result of strong industrial advocacy that has generally lacked gender and cultural diversity. The resulting policies have been precipitated from mechanisms like advisory panels, hearings, councils, environmental court decisions and appeals, all of which have established, contributed or upheld perverse and/or high-risk outcomes, designed to protect business as usual over and above continuing impact on receiving environments.

Examples include:

- Grandparenting allowances for nitrogen-leaching land values around Lakes Rotorua and Taupo have been rewarded with increased land values.
- The One Billion Trees incentive is resulting in rewarding monocultural plantations of exotic species, while penalising innovation to plant smaller, native plantations and corridors that do not qualify for ETS credits.
- Under the ETS, transferable credits from dubious Northern Hemisphere markets resulted in the deforestation of tens of thousands of hectares around Taupo through reduced carbon offset payments ($16,000/ha to $1,600/ha) to make way for irrigated dairy on pumice, emitting more than 12,000 kg C02 Equivalent per hectare annually. This whenua now carries intensive dairy farming, where runoff enters a priority freshwater management zone of the Upper Waikato River (Simmons & Young 2016).

2.1. Canterbury Water – a detailed example of failed policy

Water allocation on a first-in-first-served basis has resulted in over allocation, intensification on vulnerable soils, significant nutrient leaching and associated poor ecological outcomes. Canterbury water is a real time example of why a regenerative and holistic approach to human activity is needed.

Intensification in Canterbury is resulting in human health implications. including increased nitrate and pathogen loads to shallow aquifers and spring-fed streams on which a significant proportion of the population rely for their untreated drinking water from bores. The risk bore drinking water presents is largely unknown and unmonitored by the people and families consuming this water, making them particularly vulnerable.

The Northern Christchurch water source now has elevated nitrogen concentration. This should have been protected by the Canterbury Land and Water Plan. The Regional Council is being pressured to provide clawbacks of nitrogen from farms of up to 80%, when only a decade ago, this catchment's farmers were encouraged to convert to intensive irrigated dairy, facilitated by permissive allocation and lending regimes, and supported by industry advocacy for increased output and volume.[1] The lack of environmental and cultural improvement under the Canterbury Water Management Strategy (ECAN) has similarly raised NGO and rūnanga discontent and disengagement. In the latest proposed plan change for the Waimakariri zone, only eight of the 17 streams and rivers will have their minimum flow increased by 2032. Both Te Rūnanga ō Arowhenua and Te Ngāi Tūāhuriri formally stated their lack of support for the minimum flows set in 2018. How can we, and why would we expect to see meaningful improvement in mahinga kai (traditional food sources) or biodiversity values when we are not even bringing ecologically significant water flows back to our mostly over-allocated catchments (Pham 2019)

Our farming practices directly impact our water and our health through:

- Intensive farming including use of tile drains, grazing winter crops in situ on slopes and vulnerable landforms, and using feed lots can lead to a build-up of pathogens in the soil (Muirhead et al. 2005) that can travel to receiving water bodies.
- Grazed pastoral areas that have higher faecal load than non-pastoral areas; some pathogens can last for years, given favourable conditions (Jörgensen 1977).
- The relationship between of *E. coli* in the soil and the concentration of *E. coli* in runoff are significantly related. The overland flow of microbial contamination, originating from cattle faeces, and its effect on water quality are well recognised (Wilcock et al. 1999; Collins et al. 2004; Orchiston & Muirhead 2011). This results in significant waterway contamination by harmful micro-organisms during periods of rainfall or over-irrigation, as evidenced with the Havelock North Campylobacter outbreak 2016 (Royal Society Te Apārangi 2017).

Sources of water supplies for drinking water, recreation, and food collection are all vulnerable to the upstream effects of land use. Cumulative effects of pastoral agriculture can result in the accumulation of zoonotic pathogens in receiving water bodies. Critical control points and interventions along the 'hydrological supply chain' therefore need to be monitored and managed to protect a 'valued supply chain' of ecosystem integrity, preserving resources for future generations and ensuring public health (French et al. 2017).

[1] Ridett Institute: A Call to Arms (2011). The Government's Economic Growth Agenda calls for a trebling of the real value of food exports to about $60 billion (in real terms in 2011 dollars) by 2025 if we are to achieve the standard of living to which we aspire. This is a real compound annual growth rate (CAGR) of around 7% over the next 13 years, a daunting task, particularly in the current economic environment.

2.2. Diminished natural landscapes

Agricultural policy has created a legacy of permissive resource allocation and lending regimes, driving linear monocultural outputs that lack diversity, resilience, and adaptability.

We are now paying the price for previous policy-driven behaviours and practices, the historical accumulation of perverse incentives, protecting rights to resource grab, intensify, and diminish the life-giving energy of our natural world. While polluters are rewarded, ecologically adaptive innovators are disincentivised and/or fundamentally penalised for trying to implement regenerative agricultural principles.

As our livestock systems and farming practices evolve and adapt, it is important to consider the short- and long-term effects of these changes on human, animal, and ecosystem health. For example, industrial production models in the dairy industry create a demand for large-scale increases in numbers of cattle, resulting in changes in land use and large areas of irrigated pasture, often on coarse soils vulnerable to preferential flow of pathogens and nutrients to receiving aquifers, freshwaters, and estuarine zones. Industrial-scale food production systems result in industrial-scale effects and legacies that not only affect the landscape spatially, but also temporally. A One Health approach considers the wider environmental, social, and public health implications and helps mitigate impacts that would otherwise burden water supplies, public health, and public amenities.

3. Putting Whenua Back in the Picture

The interconnection of the health systems between our environment, animals and people is a primary foundation of well-being. At the heart of our nation's intercultural health system is whenua – life-giving placenta – consisting of the microbe-rich soils of Papatūānuku (Earth Mother), nourished by the rains, springs, streams, and rivers originating from Ranginui (Sky Father). This soil–water combination, or whenua, provides the organic base from which terrestrial plant life emerges, capturing the energy of the sun, driving the photosynthesis engine on our planet.

The cycle of water does not stop at the river mouth. It mingles with our moana (ocean), carrying nutrients, replenishing, feeding, and flushing a complex cycle of marine life, directly contributing to our delicately balanced biosphere. In combination with currents, tides, waves, and atmospheric slipstreams, the moana also provides climatic stability, absorbs and stabilises solar radiation, oxygenates its depths, and moderates our seasons. At every point, water evaporates from its biodiversity-cloaked surface back into the waiting arms of Ranginui before again returning to Papatūānuku as precipitation.

From a Māori world view, the life-carrying properties of whenua (water engagement with active soil) – from source to sea – only exist where the energy to create, disrupt or disintegrate is in balance. This energy cycle we call mauri sits at the heart of the ancient Takarangi double spiral, representing the universe. Within the embrace of Rangi and Papa exist their three principal offspring, who maintain our biosphere balance: Tāne Mahuta is the atua or great ancestor attributed with guarding and producing terrestrial photosynthesis and animal life; Tangaroa is responsible for all oceanic photosynthesis and marine animal activity; while Tāwhirimātea is the atua who provides atmospheric conditions that check and

balance his two brothers. If the mauri of these three primary drivers of planetary life is in balance, then so is our biosphere.

Polluted Inheritance (Joy 2015) gave us an overview of the challenges facing Aotearoa in terms of protecting our water bodies and returning them to health. But it appears Aotearoa was not yet ready to accept a decade of science. We cannot spend another decade monitoring the decline of our water. Many of our water bodies and river mouths are now on the verge of critical collapse. The time for action has arrived. A 'triage department' of new leaders will have to apply therapy to springs and aquifers, from headwaters to river mouths, and from estuaries into oceans.

This situation is happening not just in New Zealand, but globally. Ecosystem breakdown with loss of both structure and function has become epidemic and is inflicting a rising toll, evidenced by broad-scale change and human suffering. Over the next 10 to 20 years humankind will be faced with the need to change at a rate never experienced before. It is the utu – the cost of humanity's pursuit of limitless growth at the expense of all other living beings on our planet.

For Māori, the concept 'tāngata whenua' means people of the soil, and more. It identifies the source of our biological existence – the placenta unique to the originating marae community that has nourished our ancestors for generations. Applied cross-culturally, tāngata whenua also equates to the health-giving properties of your wider water catchment and its ability to provide. In an Aotearoa context, healthy people, healthy ecosystems, and healthy animals are key to a healthy future. Where government agencies are bound by administrative authority, pests, contaminants, and pathogens are restricted only by the laws of nature. Health issues cross disciplines. Human health determinants often sit outside the health sector's traditional role, and so does animal and ecosystem health. These determinants include antibiotic resistance, food safety and security, water systems, disease patterns, and the effects of climate change and agricultural production systems on soil, air, and waterways (Tapsell & Dewes 2019).

4. 2021 Looking Forward – From A Changed World

The operational world of agriculture has changed over the past two decades, and the rate of change is increasing:

Figure 1. Summary of the two different operational landscapes our farming is having to adapt to between 1980 and 2020. (Dewes – 2020)

With these drivers farmers are increasingly seeking a system to adapt to 21st century expectations while replenishing the at-risk ecosystem on which they rely for a living.

Ethically driven agricultural systems must be supported by motivating policy structures, education, and cross-agency support. Their link to protecting health is not only good for our natural world, but also our whenua: our natural landscapes and waterways on which the life support capacity of our future depends.

While an ideal, this can only be achieved if all relevant parties are at the policy design table. Over 2021–2024, NZ requires a farm plan design that protects fresh water and provides incentives for our farmers to change. This should not just be about risk management but should be about a fundamental change from our present extractive agricultural systems.

For ecosystem, human, animal, and business health to be protected from unknown threats we must look more broadly and identify and assess risks such as zoonoses. To improve the outcome for known challenges to our ecosystem, human, animal, and business health, our standard points of reference and measured baselines will need to record current and present practices to empower our farmers to move towards systems of farming that replenish, rather than extract, energy, to act as worthy stewards for future generations who will also need to engage with the receiving environments for a living.

4.1. Policy design must reward safer and healthier farm systems

This means at the design table for 21st century policy we need transdisciplinary practitioners who are not solely advocates for linear growth systems that are extractive from nature, but transdisciplinary health practitioners who understand how to communicate good science, model and translate good science into policy, and educate the agricultural advisors and farm planners accordingly. These practitioners should be independent, without vested interests, and have a deep understanding of interconnected systems, innovative adaption, and responsible application.

Future farm systems and farm plans will be required to provide whenua health and well-being, not least the impact on waterways from the mountains to the sea. It is becoming understood that a river carries the fundamental right of being able to flourish as a river, transporting plentiful flows of clean water to all ecosystems so they may flourish equally, whether at source or on entering the ocean (Salmond et al. 2019). Once this is secured, people can derive health and sustenance from the waterway (Te Hauora o te Tangata), in ways that ensure Te Hauora o te whenua, wider ecosystem and environmental health. In the 2017 amendment of the policy statement, 'Te Mana o te Wai' was defined as 'the integrated and holistic wellbeing of a freshwater body' and as an integral part of freshwater management (Ministry for the Environment 2017).

Our farm systems will need to be restorative, diverse, and resilient. Our farm systems must be agile, while protecting nature-based services, providing improved soil structure, and replenishing shared receiving water bodies for future generations in an ethical and transparent manner.

4.2. Health Baselines on Farm: Measure what we can

Tipu Whenua has derived One Health scorecards that procure readily measurable KPIs for health and resilience of the Farm Business, the Animals, the People, and the Ecological Footprint of the farming system. More work needs to be done in this area, especially in what measures (KPIs) are appropriate to reflect appropriate provisioning for Nature Based Services.

While the focus is on procurable KPIs that make sense for the farmer, they must also provide simple measures that most farmers will have on hand that can substitute for risky practices, systems, and inputs that affect the animals, people, business, and environment.

Most recently, we have seen a National Policy statement for Freshwater released, and significant changes to the RMA. This is in response to a cumulative failure of policy and agency management. Over a series of decades NZ has failed to manage land use in a manner that protects our receiving water bodies (including aquifers), soils, wetland destruction, and mahinga kai.

4.3. Recommendations for a 2021 Step Change to One Health

The principles of regenerative agriculture, which aim to work in harmony with natural processes (less N, more nutrient-rich species diversity, integrated with a system of fewer, healthier stock treading more lightly on the land), should be rewarded rather than penalised, to facilitate a regenerative (replenishing) farming approach of 'getting ahead of the game' by providing a significant change to the ecosystems roadmap that guides best practice whenua, animal, and human health.

We Recommend:

- Governmental leadership acknowledges the interconnectedness of human health and our ecosystem
- A major change in regulatory design of land use change/ agricultural policy reflecting the central focus of a One health approach, underpinned by Māori World view and knowledge systems of whenua-based interconnectivity, is supported by detailed western science
- Anthropogenic nitrogenous inputs require disincentives, while endogenous nitrogen sources need incentivising (e.g. move to N fixing plants, diverse species and away from N dependant miofloral systems)
- Encourage Baseline assessment of Nature Based Services, and increased planting, corridors, and cumulative effects at catchment scale (Beef & Lamb NZ 2020)
- A long-term and holistic connectivity plan, reaching from the mountains to the sea based on hydrological catchment boundaries that provide healing potential for receiving interfaces – and associated public health impacts. Until we define the problem, we cannot design the solution
- We need equality of Indigenous people at the heart of the catchment (Kainga) in co-governing roles, to ensure whenua-enhancing principles are upheld (e.g. Hauora o te Wai), underpinned by strong environmental bottom lines that are enforceable, transparent, and independent of industrial advocacy.
- **The future farm will require incentives for desired outcomes, including**
    - Mitigating known risks (GHG), carbon sequestration
    - Simple and agile integrated systems
    - Synergies between subsystems, e.g. plant food/arable crops for humans, with by-products for animal consumption
    - Closed systems: nutrients, gas, fibre
    - Optimised animal wellbeing (noting their sentience)
    - Supporting biodiversity, replenishing soils
    - High-quality, transparent, democratised, real-time data, available to the consumer.
    - The ecosystem of connectivity be taught in schools, science institutions, and trades, to enhance creative education, and include alternative systems, such as organics, regenerative agriculture education, soil protection, and the impacts of our activities

5. Conclusions

We acknowledge the potential risk to human health from human activity, and need to act to strengthen capability in epidemiology, modelling, and outbreak management, while building pandemic plans that are flexible enough to respond to all eventualities.

NZ needs both a whenua (soils, waterways, air) plan and a connected public health plan, from the mountains to the sea, providing for both eco-system health, and the public.

We must better integrate whenua-informed land and water science and research into the health system. This requires a culture change, so research is regarded as business as usual for district health boards, providing the science needed to inform policy, preparedness, and best practice. Crucially, we need a new generation of scientists and professionals who are cross-systems thinkers and comfortable working with multiple disciplines and across the human–animal–environment interface in a cross-cultural, whenua-enabled context.

And we need the kind of leadership Nabarro called for: science-informed and forward-looking, rather than reactive. We have seen good leadership based on science[2] in the highest levels of New Zealand's government in response to Covid-19.

A One Health approach is based on groups working together; however New Zealand has a unique opportunity to be a global leader in this transdisciplinary-cross cultural-systems approach:[3]

> This approach makes particular sense in New Zealand. We are an island nation vulnerable to introduced infectious diseases, and economically dependent on agriculture and the physical environment. But we're also home to an existing Indigenous Māori worldview and knowledge system that emphasises interconnectivity between humans, animals and the environment. (Murdoch D 2020)

With Agricultural and Water and Climate reforms on the table in 2021, it is essential that we have public health advocates involved in policy design, informing appropriate land management strategies that will underpin protection of human health and well-being over time, and across the nation.

2020 -2030 is the decade to ensure that One Health becomes the 'default' and leading way of managing our landscapes and future for humanity in Aotearoa New Zealand.

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[2] https://theconversation.com/overjoyed-a-leading-health-expert-on-new-zealands-coronavirus-shutdown-and-the-challenging-weeks-ahead-134395

[3] Dr David Murdoch in https://theconversation.com/the-next-once-a-century-pandemic-is-coming-sooner-than-you-think-but-covid-19-can-help-us-get-ready-139976

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