GREENER PASTURES

Priorities for a low-footprint, high-value food producing future






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Greener pastures: At a glance

Our pastures value	● Pastures are a huge asset to the New Zealand economy, supporting $30+ billion exports and 300,000 jobs. ● They are an integral part of the New Zealand landscape and rural communities, and will remain so. ● They hold around 1.5 billion tonnes of stored carbon. ● They give New Zealand a premium position in global markets for high value, protein-rich food products through inherent 'nature-positive' attributes.
Shrinking our footprint	● Pasture-based food production, like all economic activity, creates undesirable environmental impacts. These include nitrate loss to freshwater, and relatively high GHG emissions. ● Although this is often overlooked, all the N and C released to the environment is initially incorporated and transformed by pastures. ● Therefore, innovative pasture technologies and management must be part of the environmental solution, but these have not been explored to date.
Threats exist	● Warmer, drier weather is occurring, with 2030 climate projections already being felt in some regions. ● Extra stresses such as higher insect pest and disease loads and greater weed ingress will follow. ● These challenges are a severe test of the resilience of our pastures. ● We are already seeing our pasture base fail in some regions.
Change brings opportunity	● Farm systems will have to adapt substantially to reduce environmental impacts and secure 'nature positive' benefits. ● Our pastoral industries have successfully overcome major challenges in the past, innovating through long-term investment in research and development with key stakeholders collectively driving change. ● The grazing herb plantain with its nitrogen-conserving properties is a good example of how key stakeholders can innovate together. ● We have a relatively strong foundation to pivot from - now is a good time to act to secure a low footprint, high value food producing future.
Where to begin?	● Adaptation is required. The questions are where, in which direction, and how? ● Reliance on short-term solutions to one challenge may negatively affect others, or lead to unintended outcomes and compound problems. ● Sound, systematic problem definition and holistic assessment relative to the full suite of challenges is essential for long-term solutions. ● Over the past 20 years the publicly-funded innovation system driving new pasture technologies and on-farm change has been significantly depleted and become increasingly divorced from farmer needs. ● Farmers lack confidence in their ability to participate in, and influence, the direction of RD&E; they will not act without confidence, and this must be redressed.
Actions we could take	1. Explicitly quantify what is at stake here - be clear about the economic, environmental and social value proposition for investment and action. 2. Systematically identify the risks and opportunities - build a national inventory of our pasture (and soil) resource to direct investment into the most promising opportunities. 3. Start building a national network of innovation sites focused on adaptive pasture management and associated technologies 4. Incentivise collaboration between farmers, researchers and communities to find appropriate solutions. 5. Address key human capability and expertise gaps by 2030.

Purpose

The key challenges and opportunities facing the pasture[1] resource underpinning New Zealand's pastoral industries outlined in this paper are drawn from the knowledge, analysis and feedback of 240 pan-pastoral industry stakeholders[2] who participated in the Resilient Pastures Symposium (RPS) at Karapiro in May 2021. Information on the Symposium is provided in Appendix B.

The RPS was convened in response to concerns about the resilience[3] of our pasture base to rapidly changing pressures and expectations. **The purpose of this paper is to deliver on the objectives of the Symposium**, namely to:

- synthesise the current state of our pastures as seen through the various perspectives of the delegates, and;
- propose priorities for consideration by key stakeholders, including the significant investors already supporting Research, Development & Extension (RD&E), as they address the challenges ahead.

The collective message from delegates is that New Zealand pasture-based farming needs to urgently prepare for the rapid changes ahead if it is to achieve sustainable growth in future value. This need is widely acknowledged, and whole-of-industry responses are being implemented, often in partnership with Government.

With reference to **pastures**, delegates noted that pastures and the soils they grow on can fall between the investment priorities because the major sector investors understandably operate through the lens of their respective animal product levy source: meat from beef cattle and sheep, and milk from dairy cows. There was a view that 'pastures' should have a more prominent voice, and that there is a tendency to conclude we already have all the answers required for future pasture adaptation. The publication from the Resilient Pastures Symposium (Douglas 2021) and workshop outputs contradicts this view.

The need for strategy to drive progress has been recognised in the past (Appendix C), and currently in 'Fit for a Better World'. However, a clear action plan needs to follow strategy to enable progress. In Australia, CSIRO Futures: Protein provides an example of a roadmap for action in pastoral agriculture.

This paper provides general and specific context about the **'current state'** and presents recommendations for actions distilled from the Symposium.

Context: the pastoral dilemma

Grazed pastures cover nearly 40% of New Zealand's total land area. They form an integral part of our landscapes and our communities, and will remain so into the future. They enable the low-cost conversion of solar energy into food and are a key resource for our high value animal protein industries.

However, the agricultural systems that utilise these landscapes also have an environmental footprint, contributing to New Zealand's declining water quality and increasing greenhouse gas (GHG) footprint. The defining mission of the pastoral industries over the coming decades is to simultaneously reduce their environmental footprint while retaining our ability to produce high value protein, and there is much at stake:

- Pastoral agriculture generates more than $30 billion per year of export earnings, provides employment for 1 in 10 New Zealanders (Dalziel et al. 2018) and produces high quality protein-rich food for about 40 million people.
- Freshwater quality is declining in some catchments due to factors such as a nation-wide annual nitrogen (N) surplus in our pastoral industries of 170,000 tonnes (Monaghan et al. 2021).
- The GHG footprint of pastoral agriculture is significant at 38.8 million tonnes CO_2 equivalent/annum, (Ministry for the Environment 2021), **but** pastoral landscapes also have an estimated 1.48 billion tonnes of carbon stored in their soils (Wall et al. 2021)
- Currently, there are few options for alternative economic land uses that approach the overall contribution potential of pastoral agriculture **and** have a substantially lower environmental footprint.

[1] 'Pastures' are defined as the ecosystem of plants, soils, invertebrates and microbes, and their interactions, managed primarily for productive purposes. See Appendix A for further description.

[2] Attendees were agricultural service providers (35%); researchers (32%); farmers (15%); consultants (10%); sector governance (5%) and others.

[3] 'Resilience' is defined as the ability of pastures to continue performing key functions in the face of changing climate and the requirement to reduce environmental impacts. See Appendix A for further description.

Despite calls from some quarters for New Zealand's pasture area and animal numbers to be significantly reduced, economic and land use capability factors mean it is inevitable that pasture will remain a dominant productive land use in New Zealand for foreseeable decades.

In this context, it is important to note that virtually all the water, nutrients and carbon used to produce the high value edible animal protein products we export are initially incorporated and transformed by pastures.

Therefore, pastures must be part of the solution to improve water quality, carbon sequestration, soil health and other metrics of environmental quality. Development of the grazing herb plantain as a mitigation for nitrate and nitrous oxide losses is a good example of what is possible (Judson et al. 2019; Carlton et al. 2019).

The scale of pastoral land use in New Zealand, our strong culture of science-based innovation applied to pasture development and management, and the prime position that grazed pastures create for New Zealand products in export markets are compelling reasons for us to vigorously pursue further opportunities in the pastural agriculture.

Meanwhile, there is clear evidence that pasture performance is static, or in some cases declining, even for our top farmers (Mills & Neal 2021; McCahon et al. 2021). This manifests as poorer pasture growth and pasture quality, and a plateau in pasture eaten (Chapman et al. 2020), which collectively increases the cost of food production, and, intensifies the challenge to effectively manage the resulting environmental footprint.

Productive, resilient pastures create options for balancing competing economic and environmental goals. Conversely, pastures that fail under the pressure of climate, pest and other challenges limit options and restrict our ability to exploit new opportunities.

Some factors behind declining pasture performance are known, for example the increasing frequency and intensity of droughts driven by climate change (Glassey et al. 2021) which no current, conventional pasture technologies can withstand (Lee et al. 2017). However, many questions remain. As we transition to the landscapes of the future, capable of producing high-value protein with a low environmental footprint, urgent action is required to maintain our export volumes and, more importantly, capture the exciting opportunities for increasing product value in key markets.

So what?

The emerging productivity trends noted above call into question the true physical, environmental and economic resilience of our pastures and the soils they grow on. In the past, these resources have been viewed largely through a productivity lens. That narrow view is inadequate for defining true future resilience: a holistic perspective is now essential. This has been evident for two decades, but responses throughout the innovation system have thus far been piecemeal and fragmented.

These issues can be addressed through a coordinated collaborative approach to developing new knowledge and solutions. This will require a commitment to act from all stakeholders: the dairy and red meat sector bodies via their respective strategies; Government via overarching frameworks, particularly Fit for a Better World; leading science organisations; technology developers and service providers; and farmers themselves.

The best time to meet new challenges is when we are strong. New Zealand's pasture resources remain relatively strong, but the weakening trend noted above is cause for concern. The long-term nature of farm systems and environmental research means that the timeframes to solve these problems are measured in decades. Short-term solutions carry a risk that the 'solution' to one challenge may negatively affect our ability to solve others, and lead to unintended consequences (Parsons et al. 2016). We should guard against such eventualities by drawing only on sound, holistic scientific analysis of the long-term outcomes (biological/biophysical, environmental, economic and social) of any proposed mitigation.

A key tenet of this paper is that now is the time for stakeholders to act to ensure all options are on the table for future innovation and adaptation. Several actions that can help direct future investment towards the best long-term environmental, social and economic outcomes are described in the following sections. We believe these actions are readily implementable if there is a shared commitment among stakeholders; and that if implemented, they will lay the foundation for the strong shared strategy for future innovation that is currently lacking.

The value of pastures

The scope and pace of change confronting New Zealand agriculture demands coordinated solutions on multiple fronts, including: freshwater quality, nutrient balances and management, greenhouse gas emissions animal welfare, productivity, and profitability, taking into account consumer trends and expectations. Solutions to any one of these must not result in poorer outcomes for another.

While challenging, the situation we now face is not insurmountable. We take heart from the fact that **high value animal protein products from pasture-fed cattle and sheep are a unique New Zealand asset**, with embedded 'nature positive' attributes and production efficiencies that are not easily emulated. We are world leaders in efficient pastoral farming, with an invaluable competitive advantage in top-quality, grass-fed food and fibre.

The Primary Sector Council took an optimistic view of the future in 2019 (Ministry of Primary Industries 2019):

"Our primary sectors can lead across the three pillars of New Zealand's economic recovery to achieve … ambitious targets:

***Productivity**: add $44 billion in export earnings over the next decade via a focus on creating value and building off the strong position of our core sectors*

***Sustainability**: reducing our biogenic methane emissions to 10% below 2017 levels by 2030 and to between 24% and 47% below 2017 levels by 2050. Plus restoring New Zealand's freshwater environments to a healthy state within a generation.*

***Inclusiveness:** employing 10% more New Zealanders from all walks of life in the food and fibres sector by 2030, and 10,000 more New Zealanders in the food and fibres sector workforce over the next 4 years (by 2024)."*

In the productivity pillar, the absence of emerging new industries each capable of contributing $10 billion per annum to New Zealand, this vision to grow total primary sector exports value in the next 10 years implies our pasture-based farm contribution will need to increase in total value substantially by 2030.

The emphatic opinion of pan-pastoral industry stakeholders during the RPS is that we cannot achieve this, and the other Primary Sector Council outcomes, without nationally coordinated and directed action.

The Primary Sector Council vision for primary sector leadership of New Zealand's economic recovery highlights the 'strong position of our core sectors' as a vital building block for the future. This raises several questions.

- Just how strong is the physical and human resource base currently supporting pasture performance in New Zealand?
- Can it withstand the disruptions ahead?
- What would be the consequences of failure to adapt to a more resilient state?

Public investment in pasture related RD&E has fallen steadily in recent decades and new approaches to attracting and managing investment are required.

RD&E investment directed at improving pasture productivity and concomitant environmental impact is estimated at approximately $70 million per annum from public, industry-good and commercial businesses **That equates to just $6.40/hectare, or 0.23% of the average export value generated from each hectare of pasture** (Chapman 2021). About one-third of this amount is in the commercial sector (mainly private plant breeding companies), leaving $50 million/year of 'discretionary' public and industry good investment.

Much public investment is short-term and reactive as it is required to leverage private sector investment. This comes at the expense of developing long-term industry solutions such as adaptation to a changing climate.

Pasture receives about 10% of total private and public sector investment in all primary industry sectors while underpinning 60+% of their combined export earnings. This level of investment will not support the 'strong position' required by the Primary Sector Committee to build future value.

Relative investment in pasture-related RD&E has fallen steadily in recent decades, especially from public sources, and new approaches to attracting and managing investment are required.

We recognise that mitigating climate change and improving water quality are significant challenges to address to ensure that pastoral agriculture continues to prosper and grow New Zealand's economy, and New Zealander's expectations for our environment and standard of living.

We also accept that interest from public, industry-good and private investors in pasture-related innovation and development will only accrue if there are clear and compelling environmental, economic, and social benefits in investing.

***Recommendation 1:** Provide a clear value proposition to stimulate public and private investment at farm, community/regional and national levels for the purpose of delivering resilient pastures that meet national environmental, economic and social goals: and that the collaborative response is facilitated by relevant Government Departments such as MPI and MfE.*

Innovation for pasture resilience

Delivering successful pasture innovation requires a multi-tiered approach, capable of accommodating regional and national imperatives, with equal emphasis on new discoveries and practical application.

Our guiding principles for innovation are:

- **Accelerate** - act fast to build momentum.
- **Anticipate** - audit existing forage, weeds and pests; model likely climate outcomes, and identify variations and exceptions in regional responses.
- **Collaborate** - listen to the consumer, agree on the right measures, combine resources, share successes.

Innovation is essential to ensure resilient, persistent pastures that can enhance water quality, soil stability, landscape aesthetics and animal nutrition, all within a profitable, science-based framework. Priority topics identified at the RPS included plant species for low methane, formulation of functional microbes, enhanced prediction tools, and increased use of legumes.

RPS delegates noted that the plant species and varieties required to deal with significant climate change and environmental impacts in our pastoral sector currently receive little or no private investment because - as yet - they have little market demand and commercial return. If this deficiency is not addressed, farmers will have few genetic tools to help adapt their businesses. Contributors to the solution to this market failure problem could range across public-good, levy bodies and commercial companies.

Causes of declining physical resilience in our pastures are yet to be unravelled, including the importance of roots, the role of soil and plant microbiomes and the threat of pests and weeds. Nutrients and soils must be managed more effectively: and central to this is combining the right plants and management techniques to provide continuous ground cover of actively-growing pasture plants. This minimises erosion while maximising nutrient uptake and recycling within the system. Work is required to define specific plant and management combinations for changing climatic conditions and their effects on the whole pasture ecosystem.

New pasture, soil microbiome and environmental technologies take decades from inception to delivery, and so require significant investment with limited or no direct commercial return for many years. If New Zealand pastoral agriculture is to adapt well to what lies ahead, and fulfil its future value potential, we must review and update our existing research objectives, technologies and funding models to focus on the pasture ecosystem. The potential benefits of gene editing technologies merits revisiting in this context.

All of these issues are known and pressing (Caradus et al. 2021). Some are being addressed within the public and private research sectors, albeit with very limited financial resources, resulting in slow progress (see the Value Proposition section).

What is required beyond business as usual is a focus on pasture in the unique set of environments found across the regions of New Zealand. These ecosystems, including the soils, are diverse, and incorporate and transform the water, nutrients, carbon and sunlight used to produce high value animal products at different rates and via different processes

A key to progress is to improve our depth of understanding of our current pasture resource, so we can effectively adapt to immediate and future challenges. We need to deliver direct benefits to farmers at a regional scale by developing local solutions based on a central science discovery platform. This approach would accelerate uptake through closer links between scientist and practitioner.

We recognise that the landscapes and climate of Aotearoa are unique, and that adaptations and solutions need to be locally developed.

Recommendation 2: *MPI partners with other public and private entities and industry bodies to jointly fund a regional demonstration and discovery network, overseen by local collectives of farmers, consultants, researchers and rural professionals, merging resilient pasture principles with current community initiatives such as catchment groups providing connectivity and expertise.*

We recognise that we lack critical information about our pasture resource.

Recommendation 3: *A national inventory of New Zealand's current forage base, performance trends, insect pests, weeds and diseases be created, and this information be used to identify key areas of future risk and potential, and guide future innovations from R&D investments to deliver effective solutions.*

He tangata, the people

As it stands, human capability dedicated to pastures and pasture-based systems limits our ability to meet the challenge of Te Taiao and the Primary Sector Council. We must grow this capability for the future so these skills are an integral part of our agricultural sector by 2030.

'Fit for a Better World' acknowledges that growth in the value of New Zealand primary industries will demand significantly more people, who are both well trained and supported.

The science, educational and technical components of advice and extension to farmers are currently independent and increasingly disconnected. Links between research and training back to policy and funding are non-existent. Finally, trust in science, both at policy level and by end users, has waned.

Currently, Government policy and many industry programmes, assume that rural professionals are available to assist in improving farm systems at all levels (climate change, greenhouse gas emissions, freshwater quality, biodiversity, health and safety, mental health, animal care, improved productivity and profitability). However, market failure has led to a diminishing number of rural professionals skilled in understanding whole farm systems. Without more rural professionals proficient in farm systems, environmental best practice and regulatory change, this approach will fail.

The ability of our farms to evolve and adapt, retaining the critical function of providing for local and national wellbeing, must be at the heart of any future strategy. Our rural communities have demonstrated their resilience in the past, but management practices, land use changes, and climate change now challenge the pasture base on which their ability to grow and prosper depends.

The following principles are relevant:

- Practical policy development and implementation must be a shared responsibility with active engagement from all key stakeholders.
- Co-design should be led by rural communities and iwi as they are at greatest risk of loss of autonomy and livelihood.
- Highly engaged local groups, supported by science, give rise to the greatest gains.
- Reconnection of researchers with local communities will enhance the rate of change and adaptation.

Initiatives such as community catchment groups have the potential to shift the culture toward community-led discovery combining local and national expertise. These are good examples of local groups using their knowledge and networks to develop local solutions (a Mātauranga approach) to protect our waterways. Regional expertise in project governance and securing professional input to address local issues is growing as a result.

This approach provides a trusted framework where new knowledge is developed and delivered through local networks, allowing adaptive responses to change and helping ensure future community resilience. Some of the critical challenges to pasture resilience can be met through these types of initiatives.

For these initiatives to be successful, pastures must be recognised as a key part of the solution to many of the pressing issues being addressed in regional or local projects. A view frequently and strongly expressed at the Resilient Pasture Symposium was that this point has been lost over the past two decades.

Science sector organisations must also incentivise their staff to contribute their much-needed skills and knowledge to regional and community projects. The direct impact of applied science on regional and national prosperity should be highly valued, not downgraded within science sector performance assessment criteria.

We recognise that intellectual capability, and the integration of that capability into practice change and regional development activities, has eroded over time and in its current form cannot support challenges to pasture resilience.

Recommendation 4: *The current Te Ara Paerangi (CRI Future Pathways Green paper) considerations of the structure and function of future public-good science organisations encompasses adoption and practice change as a core function. Specific careers and training in pastoral grazing systems is essential.*

Recommendation 5: *Engagement between farmers and their communities, and sector-supporting organisations is incentivised and based on sound science principles.*

Summary

New Zealand's high value animal protein exporting industries are urgently seeking solutions for the environmental impacts of their production, while anticipating a potentially bright future for products with a strong nature-positive provenance. Pastures are front-and-centre in this story, but are now required to achieve much more than just feeding animals. Improved freshwater quality and reduced GHG emissions are top of the list.

Virtually all the water, nutrients and carbon used in producing high value animal protein exports are initially incorporated and transformed by pastures. Thus, pastures should be viewed as a significant part of the solution to environmental issues, rather than being simplistically seen as the problem.

New Zealand has a strong culture of science-based innovation being applied to pasture development and management. However, 240 delegates representing multiple industry stakeholders at the Resilient Pastures Symposium (RPS) held in May 2021 identified some concerning 'cracks' in that foundation.

A key concern is the increasingly extreme climate in parts of New Zealand which is now exceeding the ability of perennial pastures to survive and perform the multiple functions now expected of them. We must therefore identify ways to ensure we have resilient pastures that also meet environmental and market expectations.

This matters to everyone, not just the farmers who are incurring the direct costs of the required change to their ecosystem service providing businesses. There is a clear national benefit because pastures support the economy through $30 b per year of exports and ~300,000 jobs, while underpinning the social fabric of our rural communities and determining regional soil and water quality.

The RPS delegates concluded that pasture-related knowledge and capability gaps limit our ability to satisfy these national interests. Farmer attendees stated that they are dis-engaged from problem identification and subsequent action. We risk losing the opportunity to link and harness farmer knowledge and pragmatism with scientific expertise to deliver innovative solutions.

Five priority actions are recommended for consideration by key sector supporting stakeholders across the public-private spectrum. These can be successfully implemented through a commitment of collaborating stakeholders to bring together the required human and financial resources. These are:

- Explicitly quantify what is at stake – the economic, environmental and social value proposition of resilient pastures.
- Systematically identify the risks and opportunities to better direct investment.
- Start building a national network of innovation sites focused on adaptive pasture management and associated technologies.
- Incentivise collaborative farmer-researcher-community engagement.
- Address human capability and expertise gaps.

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APPENDIX A

Key-word definitions

'Pastures' as referred to in this paper include the vegetative plant community that makes up a pasture plus the soils that plants grow on, associated invertebrate pests, and the plant and soil microbial organisms including disease vectors that affect the functioning of the ecosystem. They include all such ecosystems that are used primarily for productive purposes. Extensive tussock grasslands are in scope, though we note that these landscapes are subject to additional societal expectations and political objectives compared with the hilly and rolling/flat landscapes which yield most of our high value edible protein food products.

'Resilience' refers to the ability of pastures to continue performing key functions under changeable physical conditions and changing environmental, economic and societal expectations. Those key functions include:

- providing ground cover for 13 m hectares of New Zealand's land mass;
- providing ~ 95% of the feed consumed by ~ 6.5 m dairy cattle, 4 m beef cattle, 27 m sheep and 1 m deer;
- assimilating net 30 m t C/yr, and maintaining net zero soil C balance (preferably achieving net positive C balance);
- assimilating ~ 1.5 m t N/yr through biological N fixation;
- supporting ~$30 b in export earnings for New Zealand each year;
- contributing towards ~10-20% price premiums paid for New Zealand's animal protein products; and
- maintaining international competitiveness of our dairy, red meat and deer industries.

APPENDIX B

The Resilient Pastures Symposium

The Resilient Pastures Symposium[4] was convened by the New Zealand Grassland Association (NZGA), and the New Zealand Grasslands Trust (NZGT) in response to three key factors:

1. Declining pasture performance
2. Land use change
3. Declining knowledge capability

Declining pasture performance. Farmer observation as well as recent evidence from industry and research has shown that pasture performance is stagnant or declining. Failure of such pastures to survive beyond two or three years in northern dairy regions provides the challenge of ensuring continued pasture performance within a changing climate, and as a result the environmental cost of more frequent pasture renewal. Hill country pastures are also suffering loss of production (Gobilik et al. 2021). As the climate changes, those vulnerabilities are likely to be exacerbated by associated changes in insect biology (Mansfield et al. 2021).

New Zealand's maritime, humid climate is unique and does not 'map' easily to any analogue regions of the globe from which pasture solutions could be readily adapted (Caradus et al. 2021, Garcia et al. 2021).

All these points highlight one conclusion: solutions to the challenges facing our pastures and pasture-based farm systems must be largely developed in New Zealand.

Land use change. Market forces are driving significant land use change away from pastoral agriculture. Chief among these is the rising price of carbon and the move toward 'carbon farming' which is out-competing traditional hill farming enterprises in terms of financial returns but has long-term challenges with respect to impact on communities, the environment, and our ability to grow food.

Declining knowledge capability and capacity that supports sustainable food production in Aotearoa New Zealand is concerning. Significant capability in pasture research, extension, and on-farm management execution has been lost in recent decades as funding models and priorities have changed. Do we have enough expertise, funding and motivated leadership to effectively tackle the challenges ahead?

The Symposium was modelled on two previous and influential events, the 2011 Pasture Persistence Symposium and the 2016 Hill Country Symposium. Both contributed to important new initiatives for New Zealand's pasture-based

[4] See Appendix A.

farm sector, including the DairyNZ Forage Value Index; the Red Meat Profit Partnership; and formation of the Primary Sector Council.

The 2021 Symposium sought to shine a spotlight on past successes and future challenges associated with management of pastures that cover approximately 13 million hectares of New Zealand's land surface.

It featured several review papers delivered nationally and internationally recognised experts covering the current knowledge base regarding climate change, environmental impacts, Mātauranga Māori approaches to building resilience, soils, plants, pests, grazing management, systems design and regenerative agriculture.

The programme also included:

- Analysis of the Australian experience of climate change in that country's grazing industries, as a means of foreshadowing potential impacts in New Zealand.
- Invited papers delivered by farmers with a particular focus on Northland as the frontier region for climate change in New Zealand; and the people aspect of non-resilient pastures.
- Several papers reporting new technical information, much of which was prompted by the 2011 Pasture Persistence Symposium
- A 'virtual bar' session with five leading farmers sharing their perspectives on what resilient pastures meant for them.
- Structured workshops designed to elicit priorities and actions required for future success.

These workshops featured direct challenges from farmers back to science, support organisations and funders to act on their messages regarding the pace of climate change; their sense of being disconnected from and often misunderstood by research and technology organisations, and the ramifications of under-resourcing pasture RD&E in the current climate emergency.

That feedback provided much of the raw material for this paper. Further content can be found in *Grassland Research and Practice Series 17: Resilient Pastures Symposium* https://doi.org/10.33584/rps.17.2021

APPENDIX C

The Pastoral Industry Forage Strategy

In 2017, DairyNZ, Beef & Lamb New Zealand, the Fertiliser Association of New Zealand and the Foundation for Arable Research, AgResearch, the New Zealand Plant Breeding and Research Association jointly published a Pastoral Industries Forage Strategy discussion paper.

This 20-year vision of the strategy was to grow the sustainability and profitability of individual farmers and the long-term prosperity of New Zealand by increasing the value of forage grown on New Zealand farms. At the core of this are sustainable and profitable forage-based grazed farm systems.

Developed in response to a lack of a framework for investing in the industry, the unified plan sought to chart a way in which stakeholders could formally work together for the benefit of the whole industry. It contained a wide-ranging overview of the importance of pasture-based farm systems to New Zealand; a comprehensive case for a united forage strategy; future challenges facing the forage sector, and detailed recommendations.

The plan was split into four themes:

Working Together, in the recognition that multiple agencies are competing against each other for Government funding in the sector, resulting in lost opportunities and market failures

Forage Improvement, where broadening the scope of species development beyond the current small number of key temperate species, extending pasture renewal beyond cultivatable land, and, improving environmental outcomes were identified as key priorities

On-Farm Innovation, where the critical importance of converting forage innovations into workable solutions for farmers was noted as an important area for industry investment

Ready and Responsible, which recognised the impacts that rapidly changing market and environmental settings will have on future forage use and development.

In 2021, these high-level themes recurred repeatedly during the Resilient Pastures Symposium and remain very relevant. Farmers attending the Symposium clearly expressed frustration that progress on them has been minimal.

The discussion paper can be found online at Beef & Lamb New Zealand https://beeflambnz.com/your-levies-at-work/national-forage-strategy