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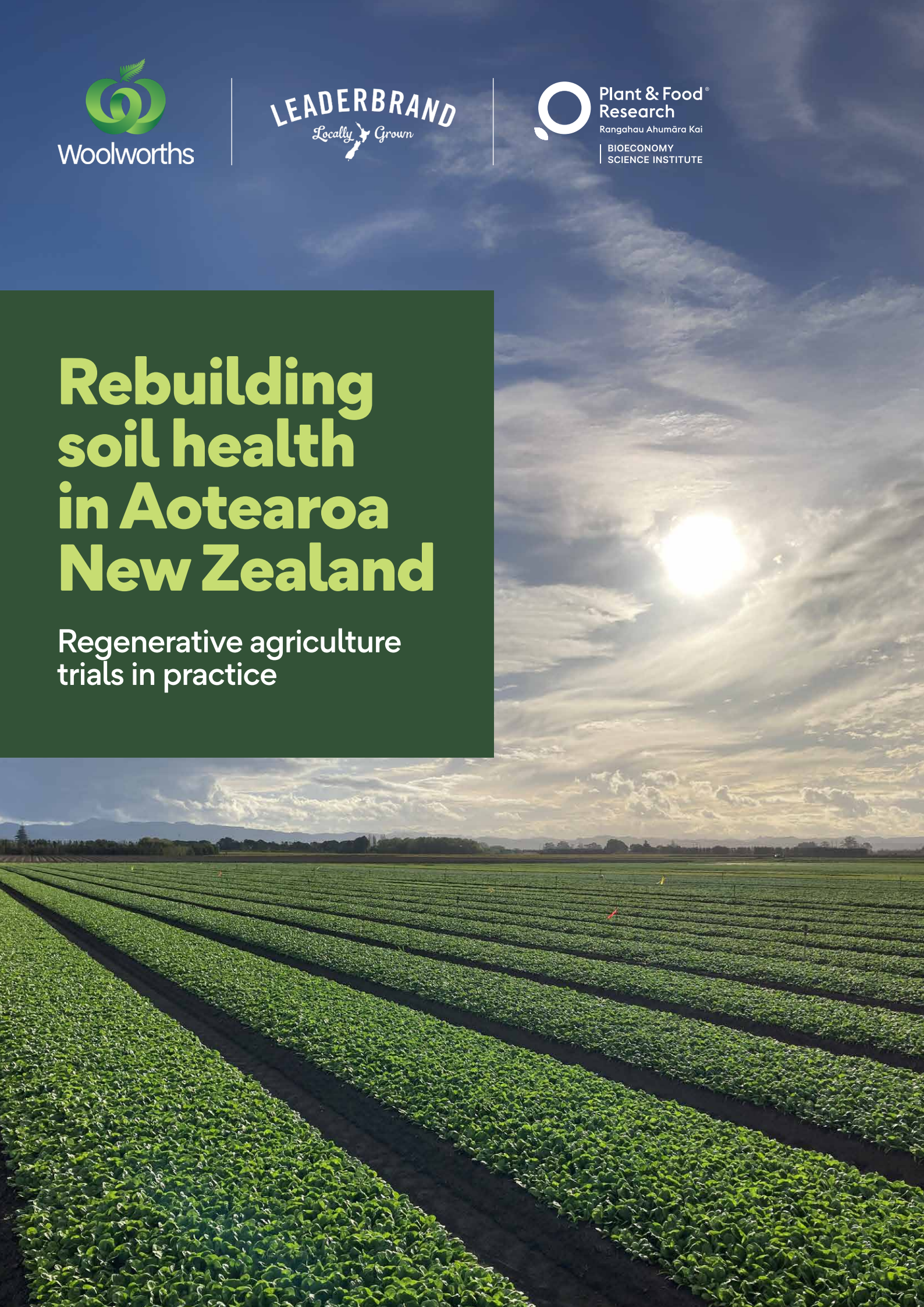
Rebuilding soil health in Aotearoa New Zealand

Regenerative agriculture trials in practice



Introduction

Few things are as vital to our society as a sustainable food supply.

Ensuring we're growing enough fresh produce to support a healthy population – now and in the future – is of fundamental importance to New Zealand's economy and our way of life.

In 2023, fruit and vegetable supplier LeaderBrand partnered with Woolworths New Zealand and the Bioeconomy Science Institute Plant & Food Research Group, on the Regenerative Management Systems for New Zealand Vegetable Production project ("the Project"). Supported by the Ministry for Primary Industries' Sustainable Food and Fibre Futures Fund, the Project aimed to assess whether regenerative farming practices could improve soil health, crop performance and environmental outcomes in an intensive, commercial setting.

The results from two field trials established in March 2023 at LeaderBrand sites in Gisborne, show how regenerative practices like compost application and cover cropping have the potential to improve soil health and boost vegetable yields.

The objective of the Project was both to test for LeaderBrand what the results from regenerative management practices could be in an operational environment over the period of the trials, and to empower growers and farmers with scientific evidence to start testing and trialling these regenerative practices. With this whitepaper, we aim to provide New Zealand growers, supply chain partners and policymakers with an overview of the Project findings, gathered over two years of field trials, to inform growing practices and decision-making for long-term, sustainable growth in every sense.

> “Healthy soil is the essential foundation for resilient crops, supporting nature’s ability to adapt to growing pressures like climate change, pests and diseases.
>
> Nurturing our soils is key to a thriving future for our communities.”

Catherine Langabeer
Head of Sustainability, Woolworths New Zealand

Why regenerative,

why now?

Globally, regenerative agriculture is gaining huge momentum as businesses explore methods of food production that work in partnership with nature to increase resilience. Regenerative agriculture is a way of farming that seeks to produce high quality food while at the same time making the land more productive and biodiverse over time. As stewards of the land, regenerative farmers are actively engaged in restoring soil health, supporting their communities, respecting animal welfare, and leaving the environment in a better state than they found it.

While there's no one defining practice, key principles are minimising soil disturbance, maximising the presence of living roots, keeping the soil covered and maximising crop diversity.

The Project's focus on regenerative agriculture is not about following the 'latest trend', but a deliberate response to the reality that years of intensive land use have had a negative effect on soil health in many prime horticultural growing areas.

Healthy soil is crucial for growing food, keeping our water and air clean, and supporting plant and animal life. In intensive vegetable production systems, maintaining or enhancing soil health is especially challenging because intensive land management practices lead to a loss of soil organic carbon, which is the backbone of soil health. Practices such as frequent cultivation, growing multiple short-rotation crops (where less organic matter is returned to the soil from crop residues), and high nutrient inputs all speed up the loss of carbon from these soils. When soil carbon is depleted, the soil loses its structure, holds less water, and becomes less efficient at holding and releasing vital nutrients.

This situation is compounded by climate change. Changing weather patterns are increasingly leading to soil erosion, too much or too little moisture, and higher temperatures that can accelerate the decomposition of organic matter in the soil. All of this is creating mounting pressure on New Zealand's precious soils – even as we require more produce to support a growing population.

It is also in opposition to traditional Māori values and knowledge systems, where there is a reciprocal relationship between people and the land – the concept of tangata ahu whenua. This is a worldview that values balance, stewardship and the wellbeing of future generations.

While regenerative agriculture is gaining momentum, there is still limited research on its effectiveness that is specifically tailored to Aotearoa New Zealand's commercial vegetable systems – particularly trials that are science-backed and run at scale.

This project was designed to plug that knowledge gap, grounded in soil science as well as in seeking solutions that maintain a healthy balance, sustaining both whenua (land) and people. The intention was to share evidence with growers, to empower them to make informed decisions and adopt the appropriate regenerative management measures to drive better outcomes.

Below: LeaderBrand's farming operations, exploring the growing process.

The experiments

What we measured and why it matters.

The trials were designed to test whether two specific regenerative approaches could improve soil carbon levels and crop yields in the short term (~2 years). These were:

1. Compost as a source of imported carbon and nutrients
2. Cover crops as a means to sequester carbon on site

The testing sites

Two sites were chosen at LeaderBrand's intensive vegetable production (IVP) operation located on the Tūranganui-a-Kiwa flats, near Gisborne.

Above: LeaderBrand's nursery in Gisborne.

At each site, two treatments or 'management zones' were implemented, comprising:

- A regenerative management zone which was subject to compost application and cover cropping
- A standard management zone where compost was withheld and fallow periods maintained.

Except for compost application and cover cropping over the regenerative management zone, trial areas were uniformly managed according to standard commercial practice.

The sites had contrasting soil types with different crop rotations and trials were run over a two-year period (2023-2025). Site 1 was a winter salad leaf rotation on a 'light' sandy soil (Waikuku sandy loam) and crops included spinach and mesclun.

The typical fallow period for this site was over the summer months, with sorghum trialled as the cover crop option. Site 2 was a summer rotation on a 'heavy' clay soil (Hauraki clay) used for sweetcorn production. The typical fallow period for this site was over the winter months, with oats and vetch trialled as the cover crop options.

The effects of regenerative vs standard treatments were then measured across three key areas, grouped broadly into soil health, agronomic performance and environmental indicators.

01. Soil health measures

focused mainly on soil organic matter and related physical and biological attributes, such as soil density and respiration.

02. Agronomic measures

include soil fertility, crop yields and nutrient uptake.

03. Environmental measures

include rainfall, air and soil temperature and soil moisture.

Glossary of key terms

Cover crops - Sometimes termed 'service crops', these are planted in fallow periods between main crops for the benefit of the soil and ecosystem, rather than for harvest.

Mineralisable nitrogen - nitrogen within organic matter that microorganisms can convert into mineral N forms that plants are able to absorb. Gives an indication of the nitrogen (N) - supplying capacity of the soil.

Nitrogen balance - the difference between nitrogen inputs (such as fertilisers) and outputs (the amount taken up by plants). Large N surpluses indicate inefficient use which can increase the risk of losses to the wider environment (i.e. through runoff, leaching and greenhouse gas emissions).

Nutrient cycling - the process by which essential nutrients move from the soil environment to plants and back again. In a healthy production system, nutrients are retained in the system for longer, reducing losses and enhancing soil fertility.

Biological respiration - Refers to the process by which soil organisms, including microbes, plant roots, and soil fauna, convert organic matter into carbon dioxide (CO_2). A key indicator of soil health, as it reflects the activity of microbes in the soil and the decomposition of organic matter.

Soil carbon - Refers to the carbon (C) stored in soils in both inorganic and organic forms. Organic C is the component found in soil organic matter and plays a vital role in soil fertility and structure, water retention and climate regulation.

The results:

Soil is coming back to life

The results of the trials were very promising overall in terms of the potential impacts of regenerative agriculture, with two broad findings.

- **Regenerative management interventions can improve soil health and crop productivity, even in the short term**

The use of compost and cover crops resulted in measurable improvements in soil health within two years, with four out of six cash crops showing increased yields. At the sandy site (Site 1) in particular, notable increases in salad leaf yields were observed (on average 45% more biomass in the regenerative zone).

While net improvements in top soil total C (0-15 cm) were relatively small (e.g. 0.1% at Site 1 and 0.4% at Site 2), biological respiration and soil physical measures showed larger gains, especially at Site 2 where regenerative practices significantly improved soil tilth and aeration.

This indicates that regenerative practices can deliver tangible benefits in a relatively short timeframe, even within an intensive vegetable production environment, and that continued intervention could boost soil health even further.

- **Cover cropping is a valuable tool in regenerative management systems**

Despite the additional effort and cost, cover crops are an effective tool for improving soil structure (e.g breaking up compacted soil) and cycling N within the system. This can enable substantial reductions in the amount of synthetic nitrogen fertiliser required for subsequent cash crops.

At Site 2, where a vetch cover crop was established in Year 2, sweetcorn yields were comparable with those in the standard zone despite a 34% reduction in N fertiliser inputs

The vetch acquired close to 150kg N/ha. This demonstrates a clear pathway to reducing reliance on synthetic nitrogen fertilisers.

Results from Site 1 also indicated that regenerative management practices can improve crop resilience to nematode pressure. At this site, increased yields in salad leaf crops were seen in the regenerative zone despite a severe nematode (roundworm) infestation.

Notably, regenerative practices had only been used for 18 months on the site, suggesting that even small improvements in soil health can be beneficial for reducing the impact of nematode infestations. As a result of the Project, LeaderBrand will be continuing to explore cover cropping on the sites as part of its regular rotation.

Regenerative management practices improved soil health measures within

2 years

4 out of 6

cash crops showed increased yields

A vetch cover crop

increased sweetcorn yields

despite a 34% reduction in N fertiliser inputs*

*(Site 2, Year 1)

Below: Industry guests hear from the project working group in Gisborne.

Above: One of three field days held at LeaderBrand's farming operation in Gisborne, attended by government, industry and media representatives.

Key takeaways for growers

The research also highlights where regenerative management practices show potential to improve outcomes, as well as where some approaches may be unsuitable or require further investigation due to the limited duration of the field trials. Key learnings to help growers successfully adopt regenerative practices are:

- **Carefully consider cover crop selection**

Hairy vetch performed extremely well in the trial, but it's worth testing other cover crops for suitability to particular sites, soil types and pest pressures. For instance, sorghum, while producing good biomass and retaining nitrogen, can have roots that are slow to break down and it can also act as a host plant for problematic nematodes. Establishing and managing cover crops well is also crucial to successful outcomes. For example, planting a winter cover crop when soil temperatures are too low (e.g. in late autumn) may result in poor growth.

It's also important to use nutrient management tools like the nitrate quick test to monitor the effects of cover crops on nutrient availability. For example, the nitrate quick test was found to be very useful for assessing whether N side-dressing was needed, especially when cover crop residues were breaking down and releasing N. Testing helped avoid unnecessary fertiliser use when it was already being supplied by the cover crop residues.

- **Compost should complement, not replace, synthetic fertilisers**

While no two composts are the same, findings from the study suggest that compost should not be viewed as a primary, fast-release nutrient source in intensive vegetable production systems. Nitrogen release from the compost source was slow and insufficient to meet N demand for the vegetable crops assessed in the study.

"What works in one context may not be effective in another. For example, we found that compost may not be the best source of organic matter due to transport costs, availability, food safety requirements and risks associated with poor-quality product.

Nevertheless, some general principles remain widely applicable, such as maximising the presence of living roots and minimising soil disturbance. These foundational practices can guide adoption of regenerative agriculture practices across diverse farming systems."

Matt Norris,
Scientist,
Plant & Food Research

> There is no doubt these practices have the potential to positively impact our soil resilience and performance. However, vegetable crop rotations can be very unique. My advice would be to take an incremental approach, testing how to best incorporate one or a few new regenerative practices into a working farm system."

Gordon McPhail
General Manager
Farming, LeaderBrand

Benefits appear to be related more to soil conditioning (e.g. improved seed germination and root access to nutrients) and longer-term soil health, rather than short-term nutrient supply, although additive effects remain unclear.

It is also important to be aware of the risks around compost application in IVP systems, particularly around use of poor-quality product. This was highlighted at Site 2 in Year 1 where sweetcorn yields were negatively impacted by a batch of compost derived from paunch material (partially digested material from animal stomachs), which reduced plant vigour and yields and introduced weeds.

- **Test and tailor regenerative treatments for individual sites**

Despite lower C inputs at Site 2 (heavy clay), improvements in soil health were greater here compared to at Site 1 (sandy loam). Heavy clay soils are generally more effective at retaining additions of organic matter. This underscores the need for tailored regenerative approaches rather than a one-size-fits-all solution.

For example, different strategies for carbon sequestration might be necessary for different soil types. For sandy soils, the use of more stable organic material (like biochar) in conjunction with more efficient nitrogen use could help to slow down the loss of organic matter.

Conclusion

What this means for the future of vegetable farming

We know we're looking at a future that is likely to place increasing pressure on where and how we source our fresh food. With a growing consumer market, and one which is increasingly conscious of farming and growing practices and their impact on our environment, regenerative agriculture offers exciting opportunities to grow production while supporting a healthy ecosystem.

Far from being in opposition to intensive commercial growing systems, the data show regenerative practices can be successfully integrated for greater yields and healthier soils in an IVP setting, potentially boosting commercial outcomes, and increasing the stability of our food supply chain. Improvements can be seen even in a short time-frame.

Empowered by this knowledge, Woolworths New Zealand is exploring supporting wider adoption of regenerative practices across its grower networks. Further investment in science-backed sustainability initiatives is planned, acknowledging that while some promising trends have emerged, longer-term trials of at least five years are needed to evaluate enduring impacts.

In the future, the Project team is considering investigating alternative carbon-stable organic amendments, such as biochar, which may be more effective than compost at improving soil chemical and physical properties on degraded soils and can act as a long-term carbon sink.

"The trials have demonstrated some of the practical difficulties of working with compost at a large scale in our situation: consistency of nutrient levels, chemical composition and low weed seed burden can be difficult to achieve. This has caused us to re-think our approach, including the potential use of biochar as a carbon source. Both cover crops and compost have had a positive impact on soil health but require a more refined management and rotational system which we need to develop," says LeaderBrand General Manager Farming, Gordon McPhail.

While not all regenerative management practices may be suitable for every site, and require continued research, the data shows sustainable methods aren't just a nice to have – they promise to be an effective means of supporting a thriving food system in Aotearoa New Zealand.

“What we’ve learned is that understanding how to best integrate regenerative management practices to improve soil health takes time. It can take up to a thousand years for just a few centimetres of topsoil to form, so the fact we saw these results in just a few years is fantastic. It’s been exciting to see early benefits coming through - and opportunities for how our growers might incorporate these practices into their own operations.

It’s great to find that our customers are also keen to understand what regenerative agriculture is, and we want to do more to help our customers learn about this approach. We’ll continue to share the learnings from this project with our network of more than 100 direct fruit and vegetable suppliers and work to understand how we can best help them to support a thriving food system in Aotearoa New Zealand.”

Catherine Langabeer
Head of Sustainability,
Woolworths New Zealand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