Welcome to the Soil News

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In this issue…

Your contributions are required - New Zealand Soil News is your newsletter

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From the Editor

Welcome to this issue of Soil News.

New Bioeconomy Science Institute

On 1 July 2025, the New Zealand Institute for Bioeconomy Science Limited was formed. The operating name used day-to-day is Bioeconomy Science Institute.

The Bioeconomy Science Institute (BSI) brings together AgResearch, Manaaki Whenua – Landcare Research, Plant & Food Research and Scion into a single organisation. They will operate as groups within the BSI. BSI has more than 2,000 people, including more than 1,500 scientists and researchers.

Keep a look out for more information.

Editorial: From China to New Zealand: Global soil-science insights for local action

Wei Hu and Brent Clothier

Earlier this month (2-5 August), we had the privilege to be invited to attend the Soil Physics and Smart Agriculture Annual Conference in Yantai, Shandong, China. It was hosted by the Soil Physics Committee of the Soil Science Society of China. The meeting brought together researchers from 12 countries, covering topics from millimetre scale root-soil interface to catchment-scale hydrology. Over 600 scientists, students, industry professionals, and government representatives attended the meeting.

The conference focused on six topics: Soil improvement and enhancement of land productivity, soil modelling and smart agriculture, soil moisture–crop relationships and water-saving agriculture, soil hydrological processes and farmland nutrient management, physical–chemical-biological interactions and soil health, and comprehensive utilisation of saline-alkali land and water-salt regulation. The breadth of research was impressive, but an even stronger impression came from the underlying unity of the message: soil physics is not a narrow technical discipline, it is the fundamental foundation upon which food security, water resilience, and climate solutions depend.

As soil scientists working in New Zealand, we viewed presentations through dual lenses: first, appreciating the intrinsic scientific value of international merit; and second, reflecting on its implications for our soils, land uses, and environmental challenges at home.

Below, we share the themes and ideas that resonated most with us, along with thoughts on how they might inform soil-science research and practice here in Aotearoa New Zealand.

Soil physical health: the overlooked foundation of ecosystem services

Several talks, including one of ours (WH), focused on soil physical health, the structural integrity and hydraulic functionality of soils, as being a critical determinant of multiple ecosystem services.

Compaction, altered porosity, and reduced infiltration capacity are widespread forms of physical degradation. These limit root growth, reduce water storage and drainage capacity, and increase the likelihood of surface runoff carrying sediment and contaminants. Over time, such changes cascade into ecosystem disservices: increased nitrate leaching, elevated nitrous oxide emissions, and diminished climate resilience.

For New Zealand, the parallels are clear. Our intensive dairy, horticultural, and arable systems regularly exceed soils' load-bearing capacity, especially when wet. In these systems, physical degradation undermines the potential to achieve environmental and productivity goals.

A key takeaway from the conference was the urgent need to embed soil physical health into management frameworks through practical metrics, monitoring programs, and decision-support tools that explicitly track and protect soil structural quality.

Roots as soil engineers

Paul Hallett's (University of Aberdeen) talk, "Rooting for Soil Physics," reminded us that plant roots actively shape soil physical properties. Through root architecture, root exudates, and physical pressures, roots influence aggregation, porosity, and hydraulic conductivity. Some species are better than others at creating, or maintaining, beneficial soil structure, and these traits can be harnessed in breeding, or through rotation design.

For New Zealand, this raises exciting possibilities! Could we select grass cultivars with root systems that rebuild soil structure faster after grazing-induced compaction? Could horticultural rotations incorporate "soil-structuring" cover crops to restore infiltration capacity between high-traffic periods to reduce soil aeration stress and runoff risk? Could breeding programs integrate root–soil interface mechanics alongside yield and disease resistance criteria?

This line of thinking aligns well with regenerative-agriculture principles, and grounds them in measurable physical outcomes.

Preferential flow and water redistribution

Research on stemflow, macropores, and subsurface connectivity in forested catchments, such as studies by Markus Flury (Washington State University) and Daniele Penna (University of Florence), highlighted the importance of preferential flow pathways in redistributing water and solutes.

In New Zealand, preferential flow is a double-edged sword. In well-structured soils, it rapidly recharges groundwater and sustains baseflows. In heavily fertilised systems, it can bypass the biologically active matrix, increasing nutrient leaching risk.

Our hill country pastures, plantation forests, and native bush all exhibit varying degrees of preferential flow, influenced by slope, vegetation, and soil type. Yet, current regulatory frameworks and nutrient budgets tend to treat drainage as a uniform, matrix-dominated process.

Incorporating preferential flow into nutrient management modelling and risk assessment is an important area of study with direct implications for policies, such as freshwater farm plans and contaminant loss limits.

Climate-smart amendments and resilience strategies

Several talks explored innovative interventions to protect soil physical function under stress. One of us (BC) delivered a keynote discussing the "Opportunities and Challenges at the Food-Water-Energy Nexus in Arid Soils Irrigated with Saline Groundwaters", highlighting new strategies for climate-smart soil and saline-water management. This was followed by several presentations on saline remediation efforts in China, a high-priority topic supported by national initiatives aiming at protecting farmland and ensuring food security. Liaqat Ali (China Agricultural University) and colleagues demonstrated that combining biochar with plant growth-promoting rhizobacteria significantly improved maize drought resilience, increasing yield while enhancing aggregation, porosity, and microbial activity. Natasha Manzoor (University of San Luis Argentina) presented promising results for biogenic sulfur nanoparticles mitigating salinity stress in tomatoes by improving ionic balance and rhizosphere microbiome composition.

While some technologies are not yet ready for New Zealand's regulatory or market context, they signal a broader shift: integrating physics, biology, and technology to manage soils as living, multifunctional systems. Regions like Hawke's Bay and Canterbury, facing rising drought risk, may benefit from local trials of biochar-microbe strategies. Globally salinity is predicted to affect 50% of arable soils. Here in New Zealand, and across the Pacific, coastal and irrigated areas are confronting salinity challenges. We need to explore soil-plant-microbe engineering as part of our adaptation toolbox for salt and drought.

Soil science across scales: from pores to catchments

A major strength of the conference was its multi-scale perspective, linking nanoscale mineral-organic interactions affecting carbon stability, to catchment-scale ecohydrology in semiarid Argentina.

This is highly relevant for New Zealand, where policy targets are often set at regional or national scales, but the underlying processes operate at the pore and pedon scale. For example: Meeting nitrate leaching limits depends on macropore connectivity in specific paddocks; Achieving carbon sequestration goals depends on micro-aggregation stabilising organic matter; Improving drought resilience requires both field-scale water storage and catchment-scale recharge dynamics.

A robust soil science research ecosystem must connect these scales, ensuring local measurements inform national strategies, and broad goals are grounded in physical reality.

Implications for New Zealand soil research and a call to action

Although the conference focused on soil physics, its lessons extend across all branches of soil science: physical, chemical, and biological. These domains are inseparable: the physical arrangement of pores controls the chemical environment, and the habitat for microbes, while chemical and biological processes influence aggregation, stability, and hydraulic behaviour. Everything is linked, and the challenge is to unravel and understand the linkages.

Drawing from the conference themes, we see following potential focus areas for New Zealand's soil science:

• Embed soil physical health in monitoring alongside chemical and biological indicators, including structure, porosity, and hydraulic function.

• Use plant and microbial traits to enhance aggregation, infiltration, nutrient cycling, and disease suppression.

• Consider preferential flow in nutrient, contaminant, and biosecurity assessments.

• Evaluate climate-smart practices using yield, water, nutrient, greenhouse gas, and biodiversity metrics.

• Promote cross-scale, interdisciplinary research linking soil physics, biology, and chemistry to inform policy.

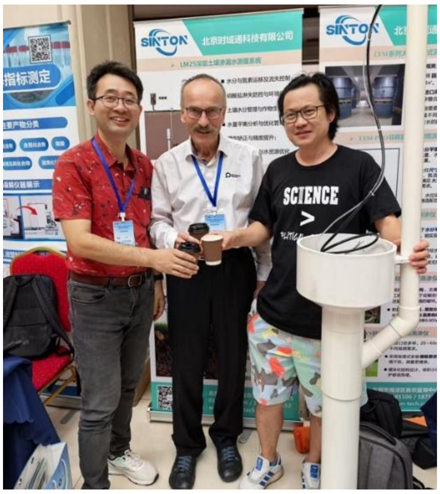
This conference reinforced a conviction we have long held. Soil physics is not "background", or a niche field. It is common ground, where water, air, nutrients, and life converge. Every farm management decision, environmental policy, and climate adaptation plan is based on assumptions about soil physical behaviour and function.

If those assumptions are flawed, or incomplete, the outcomes will fall short. But if soil physics is recognised, integrated, and actively applied across disciplines, we can unlock tremendous gains in productivity, environmental health, and resilience.

New Zealand has a vibrant soil science community, but the challenge remains to elevate the visibility and impact of our science beyond disciplinary boundaries. This requires clear communication, cross-sector collaboration, and a commitment to treat soil physical, chemical, and biological health as fundamental, and of practical utility.

As climate change advances, and land use pressures grow, we cannot afford to relegate soil science to an afterthought. The lessons from the China soil physics conference are clear. Measure it. Model it. Manage it. Protect it. To safeguard our soils, we need every facets of soil science to be linked and applied.

Opening ceremony of the Soil Physics and Smart Agriculture Annual Conference in Yantai, Shandong, China, bringing together researchers, industry partners, government representatives, and students.



From left to right: Wei Hu, Brent Clothier and Chinese collaborator Benye Xi, standing with industry sponsor Beijing Shiyu Tong and a demonstration of the ‘draingauge’ flux meter used to measure unsaturated drainage and leaching

NZSSS Submission: Proposed Changes to National Policy Statement for Highly Productive Land

July 2025

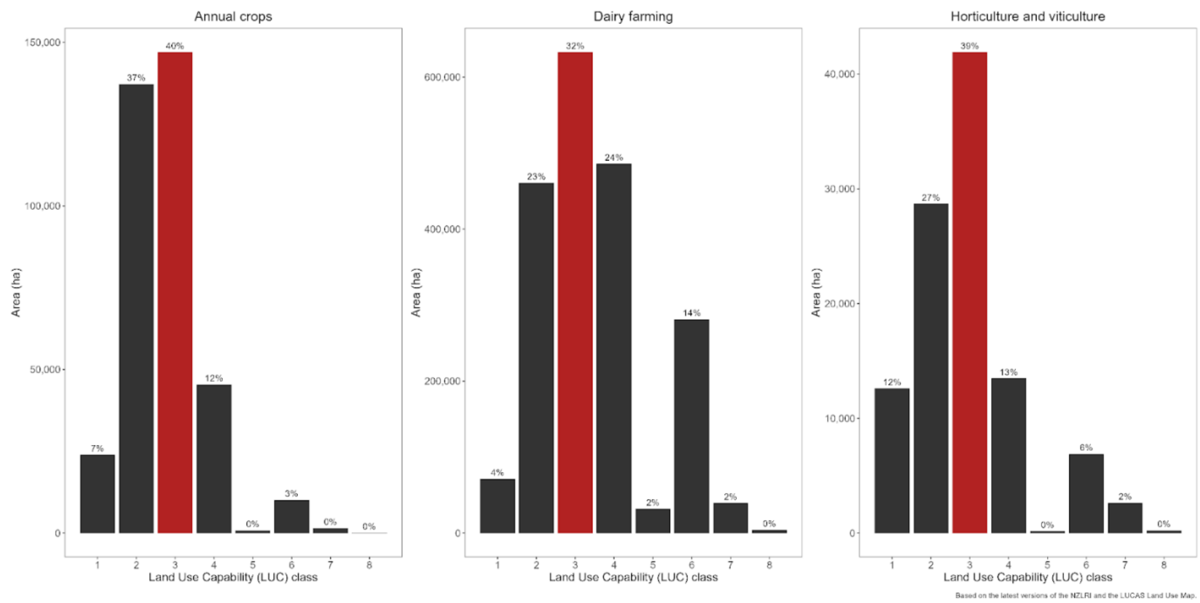
Context
The National Policy Statement for Highly Productive Land (NPS-HPL), published in 2022, sets national direction for the management of highly productive land under the Resource Management Act 1991 (RMA). The Government has proposed significant amendments, including removing the protection currently afforded to Land Use Capability (LUC) class 3 land. Submissions on the proposed changes closed on 27 July 2025, with members of the NZSSS Council preparing a joint response on behalf of the Society.

Media coverage
NZSSS representatives have been busy providing expert commentary through a range of media channels over the past few months, helping explain the significance of the proposed NPS-HPL changes and their potential impact on our most versatile land:

- Science Media Centre expert reaction: https://www.sciencemediacentre.co.nz/2025/07/22/opening-up-highly-productive-land-for-housing-expert-reaction/
- Interview on RNZ “Nine to Noon”: https://www.rnz.co.nz/national/programmes/ninetonoon/audio/2018994999/balancing-between-land-for-food-and-land-for-housing
- Interview for “The Press”: https://www.thepress.co.nz/nz-news/360721006/some-nzs-best-farmland-could-be-opened-housing

Summary of the NZSSS Submission
Land Use Capability class 3 (LUC3) land forms the backbone of Aotearoa New Zealand’s food and fibre production and high-value exports. Food and fibre exports are projected to reach $60 billion by June 2025 (MPI, 2025), with the Government’s “Going for Growth” plan aiming to double this by 2034 (MfE, 2025a). Much of this growth relies on the productive capacity of LUC classes 1-3 land, with LUC3 being of strategic national importance and supporting a wide range of primary production from dairy and arable farming to viticulture and horticulture. The National Policy Statement for Highly Productive Land (NPS-HPL) currently protects LUC classes 1-3, which together cover around 14% of Aotearoa New Zealand’s land area (MfE, 2024). LUC3 makes up two-thirds of this area, and removing its protections would leave less than 5% of the country’s land protected.

The figure below illustrates the significance of LUC3 land for three critical primary industries (annual crops, dairy farming and horticulture and viticulture) compared with other LUC classes. For all three land uses, LUC3 land makes up the largest LUC class by area.



Total area (ha) by Land Use Capability (LUC) class used for three key primary industries. Based on the latest versions of the NZLRI (MfE, 2021) and the LUCAS (MfE, 2020) Land Use Map.

LUC class 3 land underpins many of Aotearoa New Zealand's most productive food-growing regions and is of national strategic importance to the country's food and export supply. In Northland, important horticultural hubs such as Kerikeri are situated predominantly on LUC3 land. The country's largest area of vegetable and cereal crop production is on the Canterbury Plains, where LUC3 land makes up the largest proportion (41.4%) (MfE, 2020, 2021). In Taranaki, 80% of LUC3 land, and over 60% in the Waikato, is used for high-value dairy exports (MfE, 2025b). There are many other examples across the country, including the Gisborne Plains, Bay of Plenty, Hawkes Bay, Tasman, and Central Otago – all of which are crucial to the nation's food production and supply (MfE, 2020, 2021).

LUC3 land is characteristically extensive and highly productive, supporting large-scale farming and a wide range of crops across New Zealand's varied climates. If the protection of LUC3 land were removed entirely, New Zealand would risk losing large, connected and versatile areas of land. Once this land is fragmented or built on, its productive capacity is permanently reduced or lost. Baseline mapping figures from the NZ Land Resource Inventory (NZLRI) underestimate actual losses; in Auckland, for example, 19% of LUC3 land is already zoned for development (MfE & StatsNZ, 2021).

The New Zealand Society of Soil Scientists opposes a blanket removal of LUC class 3 land from protection under the NPS-HPL.

Blanket removal of protections of LUC3 land from the NPS-HPL is not required to achieve the housing goals the Government has set. Exceptions to the current NPS-HPL already exist that allow councils to approve urban development on LUC 1-3 land when justified (MfE, 2024). Any exemptions for urban development should apply only to council-led urban rezoning, not private plan changes, to ensure strategic alignment with infrastructure and cohesive land use planning. Meanwhile, blanket removal of LUC3 protections risks large-scale rural residential subdivision, which is an inefficient use of our best land. Rural residential blocks on LUC class 3 land now take up an area equivalent to nearly 60% of all the land in New Zealand used to grow vegetables (Curran-Cournane et al., 2021), highlighting the scale of land lost to low-density residential development. This type of development breaks up productive farmland into smaller, disconnected parcels, which not only makes the land harder to farm efficiently but also introduces new pressures because of 'reverse sensitivity' – when new residents in rural areas object to normal farming activities, leading to restrictions on farms (Andrew & Dymond, 2012; Curran-Cournane et al., 2021). These impacts reduce the overall productivity and versatility of the land.

The Regulatory Impact Statement outlines 4 different policy options, ranging from a status quo to a complete removal of LUC3 protections. One of the more balanced options would allow councils to enable urban growth on LUC3 land through local planning processes, while still protecting that land from residential lifestyle subdivision. This targeted approach would support housing goals near urban areas without opening the door to uncontrolled sprawl across the wider countryside.

The proposed Special Agricultural Areas (SAAs) are poorly defined, with discussion to date focussing only on two regions (Pukekohe and Horowhenua). Signalling out these high-profile regions raises concerns about transparency, national consistency. The effectiveness of any land protection system would depend on it being grounded in biophysical land qualities, rather than current land use. The narrow focus on high-profile regions risks excluding other significant food-producing areas and ignores future shifts due to climate or market changes. Establishing a new concept of SAAs may also be less efficient than refining the existing LUC system, which already covers the whole country and is based on scientific land assessment. There is also a risk of a "gold rush" effect if LUC3 protections are removed before SAA definitions and mapping are completed, leading to rapid loss of valuable land. Without clear criteria and wide consultation, SAAs may create confusion and leave large areas of valuable land unprotected – especially if protections on LUC3 land are lifted before the SAA framework is finalised.

The loss of LUC3 land is occurring alongside more frequent extreme weather events (e.g. Cyclone Gabrielle and the Auckland floods in 2023) which caused widespread crop losses in major food bowls (MFAT [2023], Treasury [2023]). Domestic food prices are already under pressure, with fruit and vegetable prices increasing by around 45% between 2014 and 2023 (Vatsa & Renwick, 2024), significantly more than for processed food. Protecting LUC3 land is essential to maintaining both food security and export capacity in the face of climate and market volatility. The precautionary principle should be applied, given the irreversible nature of LUC3 loss (Curran-Cournane et al., 2021).

Links to NZSSS Submission & Govt. Discussion Documents
NZSSS Full Submission Document:
https://drive.google.com/file/d/1GGBHSfJ7WlNJyzAFUGphbcz8Z1YegFEy/view?usp=sharing
Primary Sector Discussion Document (Main Change Proposal Document):
https://environment.govt.nz/assets/publications/RMA/package-2-primary-sector-discussion-document.pdf (pages 33-40)
Proposal attachments: environment.govt.nz/assets/publications/RMA/attachment-2.4-national-policy-statement-highly-productive-land.pdf

Regulatory Impact Statement: environment.govt.nz/assets/Interim-Regulatory-Impact-Statement-NPS-for-Highly-Productive-Land.pdf

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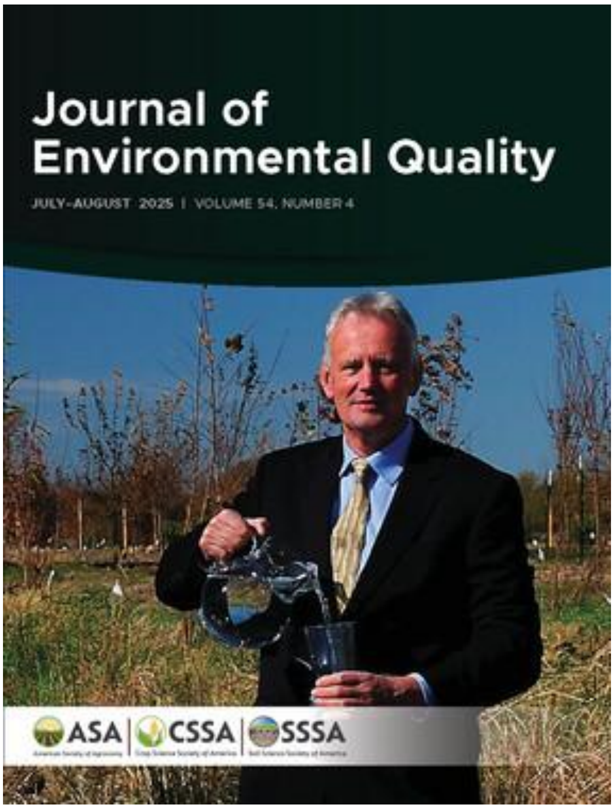
The Treasury (2023). Impacts from the North Island weather events. Available at: https://www.treasury.govt.nz/publications/other-official-information/information-releases
Vatsa, P. and A. Renwick (2024). "Food prices in New Zealand: implications for feeding people better." Journal of the Royal Society of New Zealand.

The Journal of Environmental Quality celebrates the legacy of Massey University Alumnus Dr Andrew Sharpley



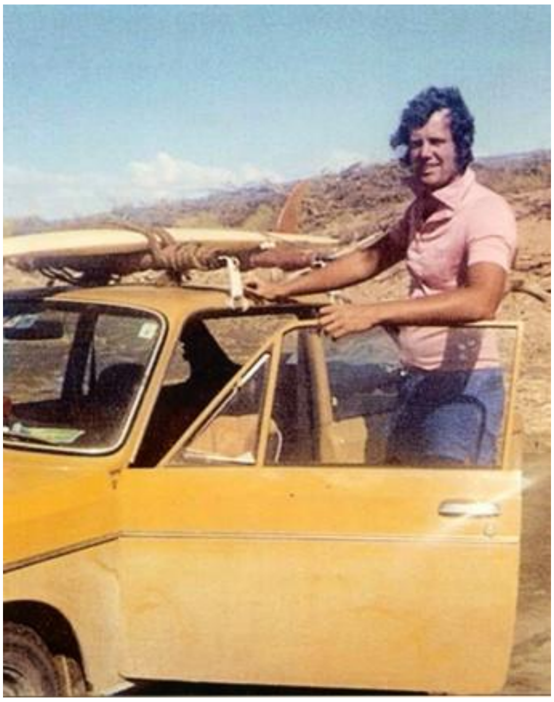
The Journal of Environmental Quality recently invited colleagues (Kleinman et al., 2025), to review the highlights of Andrew Sharpley's 44-year career, his foundational work on phosphorus management, his global influence on agricultural and environmental science, and the ways in which he inspired and influenced his colleagues and students. Did members of the Massey University Soil Society earthworm survey team (see Massey article in 'News from the Regions' section in this issue) realise that 50 years ago to the day a young Andrew Sharpley was also collecting earthworms and earthworm casts from the pastures on Massey Dairy Farm 4 (Sharpley and Syers 1976)?

Andrew Sharpley came to Massey with a BSc in Soil Science (Bangor) and was supervised for his PhD, Sources and transport of phosphorus and nitrogen in a stream draining a dominantly pasture catchment (Massey University, 1977) by Professor Keith Syers and Neil Macgregor. Andrew's thesis won the New Zealand Soil Science Society's Morice Fieldes Memorial Award (1978) for a PhD thesis of exceptional merit. Shortly after leaving Massey in 1978 Andy had a brief post-doctoral stint at the University of California-Davis working on nitrogen and in 1979 took a post-doctoral research position with the USDA ARS Water Quality Laboratory in Durant Oklahoma. In 1996, Andrew moved to USDA in Pennsylvania, where he was Lead Scientist of USDA-ARS research programme "Optimizing Nutrient Management to Sustain Agricultural Ecosystems and Protect Water Quality," as well as and an adjunct professor at Pennsylvania State University. His years of very active research in the US won him many honours including Fellow American Society of Agronomy (1990), Fellow Soil Science Society of America (1991), American Society of Agronomy's Environmental Quality Research Award (1994), Soil Science Society of America's Soil Science Applied Research Award (1998), Northeastern Branch of American Society of Americas Research Award (2001), and USDA Secretary's Honor Award (2001). In 2006 Andrew “retired” from USDA and moved to the University of Arkansas, Department of Crop, Soil and Environmental Sciences, where he became a Distinguished Professor of Soils and Water Quality. In 2010, the International Plant Nutrition Institute named Andrew as the winner of the 2010 IPNI Science Award. Andrew a long-time member of Soil Science Society of America was elected in 2015 and served as president-elect in 2016 and President in 2017. In 2021 Andrew retired from the University of Arkansas to enjoy time by Beaver lake.

In 2002, Andrew wrote a contribution to the Massey University Publication, "Moles, Mountains and Myths: A Celebration of the History of Soil and Earth Sciences at Massey University, 1927-2002". This is a commemorative publication that chronicles the rich legacy of soil and earth sciences at Massey University (Hedley and Kennedy, 2002. Massey Library Archive).

Andrew’s text about his days in the Soil Science Department at Massey University:
“I can still remember arriving in Palmerston North on a sunny spring September afternoon. As a naïve PhD student from the other side of the world, I was warmly welcomed and the adventure took off. I remember those days as most rewarding and productive. A team of researchers was assembled and housed in its own revamped laboratory, that was unique in many ways. Those were the days when I learnt how to organize and conduct laboratory and field research most effectively. Everyone involved was dedicated to the team effort, which proved to be much bigger than the sum of our varied contributions. Those were the days when we sampled and filtered runoff samples all night and then went to Keith Syers office the next day to debate the meaning of P sorption chemistry as written by Langmuir and Freundlich. Those were the days when manuscripts flowed with as easy abundance as the runoff itself. Those were the days when after a long hard week in the laboratory we adjourned to the "Fitz” for a pitcher or two, or.... And continued to plan our research and discuss its' meaning. Those were the great days that will never be repeated but the cooperation, willingness to help each other and stretch the normal bounds of our thinking have stayed with me and immensely benefited my research career since then. I feel very lucky and fortunate to have been a member of the team and to have worked with such a fine group of people. I am always amazed when I go to national and international meetings how many researchers are now conducting very similar experiments on farm nutrient management and water quality, some 25 years later. The pioneering efforts of everyone involved have stood the test of time and will continue to be the foundation for similar efforts in the future”.

A few more “senior” readers of Soil News may remember Andrew’s noisy orange Subaru GL Coupe.



Andrew Sharpley (Himitangi Beach,1976) enjoying life as a PhD student at Massey.

Our warmest congratulations go to Andrew on his stella career and hoping that he is now enjoying retirement at his home by Beaver Lake, Arkansas.

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Contributed by Mike Hedley

Permission obtained for use of photos

A range of papers in the Special Issue of Journal of Environmental Quality are available from: https://acsess.onlinelibrary.wiley.com/toc/15372537/2025/54/4

Letter by Charles Wright

Notes for Charles Wright's 1993 letter
Thomas Caspari and Dave Leslie

About the letter
The letter printed below was written by Charles Wright in 1993. The recipient of the letter is unknown. A copy was recently retrieved by Dave Leslie who recommended publishing it in "Soil News". Following a long career in New Zealand soils, Wright was living in South America at the time and was reflecting about the demise of soil surveys and scientists as well as the increasing role of "pragmatists" running the science institutions.

About Charles Seymour Wright (1915-1998)
Wright was born in England and raised in Canada. His father was C.S. Wright, a physicist and member of Robert F. Scott's British Antarctic Expedition. He came to NZ in 1936 as a young botany-zoology graduate from Leeds University. Instead of collecting plant materials to take back for his doctorate studies he took work in construction of the Homer tunnel, harvesting oysters in Foveaux Strait, and shearing and splitting totaras in the central North Island for fence posts.

One day he arrived at the door of the Whangarei Soil Survey office where work was to be had, and he became a casual labourer for Norman Taylor. Clearly Taylor and Wright clicked and, apart from soils, spoke at length on matters ecological. He would never use his return ticket to Leeds, nor see his home again for 18 years. Taylor, Wright and Charlie Sutherland evolved what they thought was a valid procedure for rapid soil reconnaissance mapping. That approach was timely. With the outbreak of WWII there was a sudden demand for soil maps of large areas, and the Whangarei office assumed responsibility for mapping the soils of half the North Island. Wright was also sent to Southland with the task of locating soil sites for growing linen flax for the war effort. Later, he was responsible for mapping the soils and preparing comprehensive soil bulletins for Samoa, Niue and Fiji.

Wright resigned from NZ Soil Bureau and left New Zealand in 1958, then spent many years making soil and agricultural surveys in countries such as British Guyana and Chile; he was appointed FAO soil correlator for South America, a position he held for some years until officially retiring in 1965 to set up home in Honduras (now Belize), where he developed a plantation and lived amongst the Maya Indians.

In 1980, Wright gave the Norman Taylor memorial lecture in DSIR Soil Bureau's 50th anniversary year. In his presentation Wright said how he watched Mr Taylor "read" the soil profile like a book: "*Little by little we came to recognise that a soil profile has characteristics inherited from the parent material, and other features that are acquired during the process of soil formation and others that are induced by the activity of humans. The first faltering steps leading to the genetic classification of NZ soils was being taken. For me it was like voyaging with Charles Darwin. Each new soil pit shed new light on the laws of nature."*

Wright died in 1998, age 83, and is buried in Toledo, Belize. He was awarded an OBE for his soils career.

About Charles Kellogg (1902-1980)
Charles Kellogg was Chief of Division of Soil Survey, USDA where he shaped the National Cooperative Soil Survey Programme. The Soil Survey Laboratory at Lincoln, Nebraska is named in his honour.

About Sir Ernest Marsden (1889-1970)
Sir Ernest Marsden was Director General of DSIR and Marsden Fund is named after him. He worked under Sir Ernest Rutherford at Manchester University where he and Hans Geiger developed the first experimental evidence for the nucleus. Marsden moved to NZ as Professor of Physics before an illustrious career as Director General of DSIR.

Further reading

- Read Charles Wright's account of his early days in New Zealand https://teara.govt.nz/sites/default/files/d-14193-enz.pdf
- Wright's 1980 Norman Taylor Memorial lecture (see p. 153-159, New Zealand Soil News 1980, Volume 28 Issue 5. https://doi.org/10.7931/DL30-1980_VOL28_5_ORC

Letter written by Charles Wright

P.O. Box 23
Punta Gorda
Belize C.A.

March 20th 1993

"Soil News" still manages to reach the mossy rock that serves as my door-step, and reading it I feel the urge to keep in touch with former colleagues. And I am in a playfull philosophic mood.

What has happened in New Zealand was probably inevitable. Indeed, parallel things are happening in many other parts of the world. The study of soils is in process of being down-graded in very many of the educational facilities in most countries. I had hoped that the New Zealand Soil Bureau might survive, but it was one of the first to go.

The concept of a Soil Bureau for New Zealand first surfaced during a beach picnic (at Waipu) during discussions between Norman Taylor, Ernest Marsden and my very humble self. Ernie Marsden spoke of the many scientists in the various branches & divisions of his DSIR that needed urgently more knowledge about soils. After another bottle or two of Waitemata, a concept emerged whereby the existing staff of the small Soil Survey Division might re-group within itself to create a Soil Information Centre. This name sounded a bit S.I.C., and so (perhaps inspired by the recent visit of Charles Kellogg) the rather high falutin name of "Soil Bureau" was approved. Most of the initial staff of the New Zealand Soil Bureau did not consider themselves as soil scientists, so much as interpreters of soil information obtained as a result of soil surveys.

When the N.Z. Soil Bureau eventually arrived officially on the scene, and new staff were brought in to help resolve unusual biological, zoological, botanical, chemical, physical etc., etc. aspects of New Zealand soils, we suddenly became “soil scientists”, - all of us.

As events subsequently proved, the study of soil is as much an Art as a Science. Norman Taylor was forever insisting that the soil was a living body. Indeed the study of its organisation was really an Act of Faith compounded in part of mythology, keen observation and deduction (bolstered by a few delicate but sound scientific ventures). Just like Christianity or Confucianism & a host of other Acts of Faith. So long as we held to the Cult of the Soil as a Living Body, we did an effective job and satisfied the customers.

However, during the last 20 years of its existence, an increasing number of dedicated scientists on the staff who believed that such a thing as a soil scientist really could exist, a wealth of new discoveries concerning minor aspects of conditions in the soil completely outstripped the act of putting things together. Scientists swamped the artists, - and Faith was gone. The Soil Bureau lost its original concept as an Act of Faith, So in the end it became easy meat for the pragmatists who must see a cash return for their paltry investments.

When the inevitable New Zealand cataclysm occurred, and the intrusion of a batholith of pragmatism threw the crust into disarray, the old Soil Bureau was an easy target for the reformers. It may have disappeared in a cloud of dust but then, as dust it will become a part of the soil and so become again a living body re-emerging at some future date. Despite Philistines, Mongol hordes, pragmatic New Zealanders, etc., Acts of Faith tend to be surprisingly enduring. The Cult of the Soil as a Living Body may not yet be finished.

In this scenario, the role of the New Zealand Soil News may achieve enhanced significance. Long may it flourish.

Editor’s note. Disclaimer: any opinions expressed are those of the writer only.

Exciting the next generation

Want to show school kids how soil science is fun and interesting but not sure where to start? The Science Learning Hub Pokapū Akoranga Pūtaiao is a website funded by the New Zealand Government and it’s full of support and resources that you can use that integrates with the curriculum.

To start with School visits – hints for scientists provides some practical ideas to help put you at ease during a school visit. This background information sets up what you might expect and your role alongside the teacher.

The Hub has curated soils resources into a couple of introductory articles. Soil - introduction has links to the basics and some easy activities (as well as an old photo – ha!). Soil, farming and science - introduction has links to resources designed for an older audience. The soils links are under the subheading Soil – linking farming, science and environmental solutions.

Māori knowledge of soils can be found in Māori soil science and Environmental monitoring – ao Māori perspectives.

We've had fun over the years with these activities:

- What makes up soil? – use this interactive graphic organiser to break the ice. It looks simple, but it's been designed to start discussions and get a quick picture of student thinking.
- Modified VSA – this works well if you have the time. Using a soil auger to create/lay out a 1 m soil profile on a tarp, which kids can observe and touch, is also a winner.
- Looking at clover nodules – hand lenses are still great tools for kids. Check with the teacher.
- Building an aquifer model – simple to build and so much to observe and discuss.

If you want to see more resources – check the Soil topic and use the filters to narrow your search. Some of our favourites are the simple ones that engage early learners and cement curiosity in science. If you specialise in other topics of science it may well be worth doing a quick search and if you like, get in contact with the team at the Hub https://www.sciencelearn.org.nz/contact-us.

Angela and Louis Schipper

Stamped with excitement: NZ Post releases soil stamps

On 4 June 2025, NZ Post issued a new set of four stamps themed around the many roles that soils play for us, and for nature.

The stamps were prepared in a collaborative effort between NZ Post and soil scientists from Manaaki Whenua - Landcare Research.

Figure: 'Soil - The Foundation of Life' Miniature Sheet.

The four stamps represent:

- $2.90 stamp: Soils & food production
- $4.20 stamp: Soils & biodiversity
- $4.70 stamp: Soils & climate regulation
- $5.50 stamp: People and the land.

Single stamps and a variety of stamp sets can be purchased from the NZ Post Collectables website at https://collectables.nzpost.co.nz/soil.

S-map updates

S-map has had some significant recent updates. Through a funding collaboration between the Ministry for Primary Industries, the Ministry for the Environment, and 12 regional councils, Manaaki Whenua – Landcare Research has completed a large area of new soil mapping coverage across some of New Zealand's best food-producing land.

August 2025 sees the largest update to S-map since 2018 with an additional 824,460 ha across Northland, Waikato, Manawatu, Taranaki, Marlborough, Tasman, Canterbury, Otago.

This total includes a remap of 11,600 ha and 2,500 ha in Taranaki and Northland, respectively. In addition, there is an area on the north Canterbury plains where the mapping linework has been slightly modified to match LIDAR imagery, and the usual suite of corrections across the country.

The S-map coverage area now totals 11.8 Mha or 44.3% of New Zealand. This is 78.2% of “multiple use” land (LUC=1-4) and 60% of farmable land. This is the final output of the five-year MPI and Regional Council S-map Expansion programme.

S-map can be accessed via S-map Online (smap.landcareresearch.co.nz). Over the last year, 60,000 factsheets have been downloaded from S-map Online.

https://smap.landcareresearch.co.nz/

Book review: ‘Interpreting soil test results: What do all the numbers mean?’

Interpreting Soil Test Results: What Do All the Numbers Mean?
Fourth Edition. By: Pam Hazelton, Brian Murphy. CSIRO Publishing.
Paperback - May 2025 - AU $69.99. ISBN: 9781486319367 | 200 pages
https://www.publish.csiro.au/book/8190/

CSIRO Publishing in Australia have recently released the 4th edition of this book. The website states it is a quick guide to interpreting a wide range of soil tests and is an essential reference for soil scientists, as well as environmental scientists, consultants and engineers.

Previous editions were published in about 1992, 2007 and 2016. The Preface reports that this 4th edition has a replacement section on acid sulphate soil, and other significant changes include new interpretation of phosphorus values, salinity, electrical conductivity, sodicity, references and other changes. The website reports that this edition also has revised information on soil carbon and contaminants.
The book has a focus on Australian results and its soils, so New Zealand readers will need to exercise some caution on some topics and New Zealand soils. The Preface reports the first edition was specifically written for government employees in New South Wales. The book now encompasses NSW and other states.

The title is catchy and very appropriate. The book includes a range of topics in 10 chapters, including soil sampling and design, soil physical properties, engineering, erodibility and erosion, chemical properties, organic matter, application of wastewater and waste materials, and soil contamination.

Topics such as sampling design, purpose, sampling for soil mapping, sampling intensity are presented first. This could provide useful context to some readers, as sampling design context is useful when interpreting soil test values. The first table presented is of the number of observations required for a soil map at various scales – a valuable starting point if the reader is unfamiliar or interested in context of mapping. In many cases a concise overview of the topic, and/or a brief overview of selected methods is provided, which can also provide useful context for interpretation.

Soil physical properties are well covered. This chapter includes a useful table of units and conversions and typical values for soil water properties. New Zealand readers will be familiar with some examples such as field capacity, and the authors state this can vary depending on circumstances. Hydraulic conductivity is well covered with typical values and tables of interpretation. Bulk density and air-porosity include relationships between them, and a brief discussion of air-porosity and adequate aeration requirements for plants. A table of general interpretation for the wet-sieve method for aggregate stability is also useful.

Further physical properties for an engineering perspective are presented, including plastic and liquid limits, earthworks and stability, and a useful range of interpretation tables. Soil erosion and erodibility are similarly presented, along with wind erodibility and aggregate measures.

Soil chemical properties include a good range, with interpretation and tables for pH (including toxicity), cation exchange etc, along with nutrient removal in some products. New Zealand readers will need to keep in mind there is a not-surprisingly Australian-specific focus for some topics in the book generally, and some terminology may be different. Some aspects may not relate easily to New Zealand conditions or soil test methods, or interpretation may be less familiar. For example, six phosphorus soil tests used in Australia are presented but these are not typically used in New Zealand; but the tables could be useful if readers have such results. Olsen P, commonly used in New Zealand, was not listed in the tables.

Not listing Olsen P in detail was surprising given its common use in some Australian states for farm soil fertility and research. Olsen P is reported as the second most common soil test in Australia, and is routinely used in Victoria and Tasmania (Gourley et al. 2019). In Victoria, a critical value of Olsen P for pasture yield was reported by Gourley et al. (2007; 2019), with a similar value reported for Tasmania (Cotching & Burkitt 2011). Gourley et al. (2019) and other studies refer to a range of recent literature on Olsen P use and interpretation in Australia – hence the book is deficient in this area. In addition, there is an extensive range of Australian studies since about the early 2000's where soil Olsen P has been extensively evaluated with farm P loss to water – such interpretation is also missing. Phosphorus buffering capacity and P buffering index is well covered; these relate to Australian conditions and references.

Some reference material in the chemistry section could be updated. From a New Zealand viewpoint, the primary reference given is Metson (1961), but this has been superseded. There is mention of techniques that have not been widely used for over 30 years in New Zealand, such as CEC using silver thiourea method, and (in the organic matter chapter) carbon by the Walkley-Black method. In New Zealand laboratories, we are not aware of any method currently and routinely being used other than the Dumas combustion (e.g. Leco analyser) for carbon. However, the organic matter chapter contains a table comparing Leco results with the Walkley-Black method, the latter of which hasn't been routinely used in New Zealand for some decades. The Chapter 6 introduction reports that Leco has replaced the Walkley-Black method. Modern New Zealand and Australian laboratories are generally well aligned typically undertaking the same tests and methodology, with a few exceptions.

As expected, salinity, sodium adsorption ratios, dispersion and several related topics, plus acid sulphate soils are well covered, some in considerable detail, so useful information is readily available for New Zealand readers, should the need arise. The application of wastewater and waste material and contaminants chapters had much useful information on interpretation of tests, and a range of soil test considerations. As mentioned above, New Zealand readers will need to keep in mind there is naturally an Australian focus for topics in the book generally, and some terminology and interpretation may be different for some numbers, our soil classification and geology, and farm systems context. Key references for further reading are provided, but are mainly Australian-focussed; some could be updated.

There are many aspects that readers should find useful to aid a 'first cut' evaluation, with a wide range of information in one place, and many pages had a table for easy interpretation. It is the tables that do much of the talking. The book would be useful initially, but some caution should be exercised when further science advice or primary sources would be more specific.

References

Cotching WE, Burkitt LL 2011. Soil phosphorus effects on ryegrass (Lolium perenne L.) production on a Hydrosol in Tasmania. New Zealand Journal of Agricultural Research 54(3): 193-202.
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Gourley CJP, Melland AR, Waller RA, Awty IM, Smith AP, Peverill KI, Hannah MC 2007. An interpretation of soil tests and a method for assessing nutrient loss for grazed pastures in Australia. Making better fertiliser decisions for grazed pastures in Australia. Victorian Government Department of Primary Industries. 17 p.

Reviewer: John Drewry, with additional insights provided by Linda Hill.

CSIRO provided a copy of the book for review.
Disclaimer: any opinions expressed are those of the writer.

Expert Perspectives: Navigating challenges to science and research

The Royal Society Te Apārangi has created 'Expert Perspectives' to present a range of nuanced views to inform public debate through thoughtful analysis.

For each topic, the Royal Society Te Apārangi will publish three or more short opinion pieces from authoritative experts, selected for their diverse experience and knowledge. In the first of their ‘Expert Perspectives’, RSNZ asked, 'How could global threats to science and research affect Aotearoa New Zealand and how might we mitigate the impact?'.

Aotearoa New Zealand must adapt to significant changes in support for science and research around the world that include cuts to research funding, censorship, ideological changes to research priorities, decreased use of evidence to inform decision-making, misinformation and disinformation, declining public trust in academics, political interference in scientific and academic institutions, and reduced support for international research collaborations.

Further information and a range of science expert perspectives:
[How could global threats to science and research affect Aotearoa New Zealand and how might we mitigate the impact?]

Selecting a quality publisher

A recent article in the Royal Society Te Apārangi Alert newsletter had a link to the RSNZ’s guidance on ‘Selecting a quality publisher’. Their six-page guidance has the introductory statement:

“Getting published is important, but not so important that you should publish in an inappropriate or disreputable journal. This guide provides information to help you navigate the publishing world, with questions to ask of a potential publisher and information on key issues in academic publishing”.

It provides 20 questions to consider when evaluating a potential publisher.

Further information:
https://www.royalsociety.org.nz/assets/Uploads/Selecting-a-quality-publisher-Nov-2017.pdf

News from the Regions

Waikato/Bay of Plenty

University of Waikato

The Waikato Biogeochemistry and Ecohydrology Research (WaiBER) team is pleased to welcome its four newest members: Postdoc V**aleria Mazzola** and PhD students **Dija Bhandari**, **Rahel Bauerdick**, and **Vanessa Victor**. Their research will expand the team's expertise in peatland restoration, carbon dynamics, and agricultural emissions.

Valeria Mazzola
Valeria is an environmental scientist specializing in carbon processes, peatland ecology, and strategies for climate change mitigation. She earned her academic qualifications in Forestry and Environmental Science at the University of Turin, followed by a PhD from the University of Aberdeen, where she focused her research on GHG emissions from restored peatlands. Her professional background includes hands-on fieldwork in both Scotland and the Falkland Islands (where she worked as a Peatlands GHG Flux Scientist at the South Atlantic Environmental Research Institute), as well as work in bioenergy systems modelling at the Karlsruhe Institute of Technology in Germany. As a postdoctoral fellow at the University of Waikato, she is involved in the MAPSERS-C project. Her research focuses on quantifying the influence of water table depth on CO_2 fluxes across peatlands under different drainage conditions. She is also involved in the maintenance of Eddy covariance towers and teaching activities within the department. Through a combination of field studies and data analysis, Valeria contributes to advancing sustainable land management and informing climate-related policy decisions.

Fig. 1 New WaiBER team member Valeria Mazzola.

Dija Bhandari
Dija Bhandari is hugely passionate about sustainable environment practices and the one health approach for planetary health. She completed her Bachelor of Science in Agriculture from Agriculture and Forestry University, Nepal. Following

that, she worked in a non-governmental organization as an agriculture officer focused on organic crop production, including multilayer farming and agroforestry practices. She completed her Master's in Danube Agrifood Master - 2023/2024 (a joint Master's Degree Program from the Czech University of Life Sciences and the University of Zagreb) in Sustainable Agriculture, Food Production and Food Technology under an Erasmus Mundus Program. She majored in soil sciences and explored seasonal soil respiration dynamics in wheat, maize, and barley in continental Croatia using closed chamber systems. She has started her PhD journey at the University of Waikato where she is focused on the biogeochemical understanding of peat C emissions with changes in water table dynamics. She will be using the measurements from the eddy covariance and chamber techniques as well as applying process-based models to study C fluxes in the drained peat soils. With her study, she aims to contribute to the GHG inventories and mitigation goals in the reversal of climate change.


Fig. 2 New WaiBER team member Dija Bhandari.

Rahel Bauerdick

Rahel's research focuses on the restoration of peatlands. She aims to better understand how soil properties, hydrological regimes, land use impacts, and the socio-cultural context all inform the analysis of these complex ecosystems. While the term 'rewetting' is gaining attention for its potential to reduce greenhouse gas emissions, Rahel's work explores whether natural restoration can occur simply by reducing land-use pressures, or if hard engineering is always necessary. Her research also investigates how social values and assumptions shape restoration targets and perceived success. Rahel is supervised by David Campbell and Louis Schipper from the University of Waikato, Jack Pronger from Manaaki Whenua – Landcare Research, and Brendon Blue from Te Herenga Waka – Victoria University of Wellington. Before starting her PhD, Rahel completed a Master of Environmental Science at Te Herenga Waka – Victoria University of Wellington after working for several years in the agricultural biosecurity sector for the Ministry for Primary Industries.

Fig. 3 New WaiBER team member Rahel Bauerdick.

Vanessa Victor

Vanessa's research focuses on nitrous oxide (N_2O) emissions during the bare fallow period, the brief but crucial time between pasture termination and the planting of a new feed crop. She uses both chamber methods and eddy covariance to monitor these emissions and investigate potential mitigation strategies, such as minimal tillage and the addition of biochar. Prior to her PhD studies, Vanessa completed a Master's degree where she examined how the plant rhizosphere influences the soil nitrogen cycle, with a particular emphasis on trace gas emissions. With a long-standing interest in the connection between soils, agriculture, and climate, she is passionate about exploring ways to enhance the sustainability of farming systems.

Fig. 4 New WaiBER team member Vanessa Victor.

David Campbell retirement
The WaiBER team is honoured to announce the retirement of Associate Professor David Campbell from his teaching role at the University of Waikato. We extend our warmest congratulations to him on a truly distinguished career and for his remarkable contributions to the education of countless students. His passion for environmental science has left an indelible mark, shaping the next generation of researchers and enriching our academic community. We express our deepest gratitude for his mentorship and the legacy he leaves behind. While David is retiring from teaching, he will return on a part-time basis from Oct to carry on his work on peat (both drained and natural).

Fig. 5 Dave Campbell with a newly extracted peat core in the middle of Kopuatai peat bog that Dave has investigated for decades.

Manawatū

Bioeconomy Science Institute (Manaaki Whenua - Landcare Research)

We celebrated 33 years of science at Manaaki Whenua, Palmerston North and at each campus. The official last day of MWLR was 30 June 2025. From 1 July 2025 we are the New Zealand Institute for Bioeconomy Science Limited.

Several current and former team members reminisced on science, support and our people over the 33 years. The Palmerston North office has strengths in land resources, soil resources, data science, land cover, soil science, soil biology, soil laboratories, proximal sensing of soil, climate change science, land stability and erosion, managing invasive species, science and people, with digital, science and technical support teams.

Photo: Cutting the celebration Manaaki Whenua cake by Kay Eastwood, Palmerston North. Photo Alister Baird.

Hugh Smith returned to Australia. Hugh led the erosion team in the Palmerston North office. Hugh contributed greatly to advancing many aspects of SedNetNZ, the STEC programme, many other programmes, publishing, plus considerable commercial work with stakeholders.

Massey University

The Massey University Soil Society took advantage of some fine July weather to get out and about on Massey's No.4 Dairy Farm in Palmerston North. The trip centred on collecting and identifying earthworms, guided by Associate Professor Maria Minor who specialises in soil ecology. Earthworms are important for mixing mineral and organic matter in the soil and improving fertility and water holding capacity to support plant production. Studies in New Zealand have found that the introduction of exotic earthworms can increase pasture production by more than 20% (Stockdill, 1982). There may be up to 1,000 earthworms per square metre, or 10 million per hectare, with their mean weight sometimes exceeding the weight of grazing animals (Schon et al. 2011).

A group of 21 students, teachers and kids went earthworm hunting in a recently grazed dairy pasture on Massey's No.4 Dairy Farm (Figure 1). A stock camp on a Rātā Terrace remnant (30-50 ka) was selected for digging. The remnant terrace surface is underlain by fine grained loess colluvium that has washed off the higher Tokomaru Marine Terrace (125 ka). The loess has weathered to produce the poorly drained Pallic soil Ohakea silt loam. The soil was below field capacity thanks to a beautiful fine week of July weather, however, was still in a plastic state and displayed evidence of slight to moderate pugging from recent grazing.

Three holes were dug to retrieve an approximately 25cm cube of topsoil. Participants were then split into groups of 4-5 to start breaking the soil apart, collecting earthworms and placing them in an ice cream container with a little soil to give them some shade. Once all of the earthworms were harvested from the 25cm cube of topsoil, the Great Kiwi Earthworm Survey guide developed by Nicol Schon at AgResearch was used to start identifying the different earthworm species. Maria Minor rotated around the groups to help with this process. Several large dark *Aporrectodea longa* (blackhead) and smaller *Aporrectodea rosea* (pink) earthworms were found together with abundant *Lumbricus rubellus* (dung) and *Aporrectodea caliginosa* (grey) earthworms.

Figure 1. Massey University Soil Society on a trip to No.4 Dairy

Figure 2: Master's student Oliver Arnold showing and explaining the significance of earthworm casts to a group of students on Masseys No.4 Dairy.

References:

Schon, N.L.; Mackay, A.D.; Minor, M.A. 2011. Earthworms in New Zealand sheep- and dairy-grazed pastures with focus on anecic Aporrectodea longa. Pedobiologia 54: S131-137.

Stockdill, S.M.J. 1982. Effects of introduced earthworms on the productivity of New Zealand pastures. Pedobiologia 24: 281-299.

Winter soil sampling at Live to Give Organic Farm, Aokautere

Building and maintaining fertile soil is a key to achieving high-yielding, environmentally resilient vegetable production systems. Healthy soils not only support reliable crop performance but also contribute to long-term sustainability by protecting against soil erosion, reducing evaporation, and enhancing soil biological activity. I am Shiromi Samiraja, a first-year PhD student at Massey University, evaluating cover cropping and direct mulch planting for improving the sustainability of vegetable production in New Zealand under the supervision of Dr. Paramsothy (Jeya) Jeyakumar and Dr. James Hanley.

The overall aim of the project is to assess the effect of cover cropping/mulching and the use of direct mulch planting of seedlings on nitrogen (N) dynamics in vegetable production, including to evaluate seasonal nitrogen availability under different cover cropping and mulching options and to quantify effect on soil health and N leaching risk.

The field trial began in April 2025 at Live to Give Organic Farm in Aokautere, where we are comparing different cover crop treatments with reduced tillage against control plots. In our first winter sampling round in July 2025, we collected soil samples from over 70+ points across different experimental blocks to a depth of 90 cm to assess the nitrogen leaching.

Figure 1: Left – View over one of the paddocks being assessed on the Live to Give Organic Farm in Aokautere. Centre – Shiromi Samiraja driving a soil corer into the ground. Right – James Hanly discussing soil coring with staff from Live to Give Organic Farm.

Paraparumu College Visit Massey's No.1 Dairy

Staff and students from Massey University had the pleasure of hosting a group of Year 11 students from Paraparaumu College on 24th July 2025. The aim was to complete some hands-on activities on Massey's No.1 Dairy to develop an understanding of soil health. Students first examined a profile through Manawatu sandy loam with Callum Rees. The students had an opportunity to feel the sandy parent material and then compare and contrast with some silty clay subsoil from Shannon. Next up master's student Oliver Arnold explained the importance of soil biology and split the students into groups of 3-4 to hunt for earthworms in 25cm blocks of soil. Finally, Associate Professor Lucy Burkit explained the importance of chemical fertility and had the students complete a soil fertility sampling transect in groups.

Figure 1: Master's student Oliver Arnold explaining the significance of soil biology to the year 11 students from Paraparaumu College.

Whenua Haumanu

Measuring the effect of diverse pastures and regenerative management on soil carbon stocks is a critical part of the Whenua Haumanu project. We are currently taking our year 4 deep cores and then we will come back at the end of the project (year 7) for a final measurement. This component is being led by Paramsothy (Jeya) Jeyakumar and Andrew Boot, with the support of Manaaki Whenua Landcare Researchers Pierre Roudier, Mandy Barron and Paul Mudge.

Figure 1: Andrew Boot cutting up a soil core on Massey’s No.1 Dairy.

Figure 2: Jayani (Masters student) and husband Harinda retrieving a soil core on Masseys No.1 Dairy.

🌱 Shelterbelts Could Transform New Zealand's Pastoral Future?

"Imagine if a simple, natural solution could simultaneously boost soil nutrients, increase soil carbon storage, and enhance farm profitability, all while requiring minimal investment or disruption to existing farming operations. That solution exists, and it's been quietly growing along the edges of New Zealand farms for decades."

🎯 **Why This Matters**:
New Zealand's pastoral agriculture occupies 39% of our land area, facing environmental challenges including soil degradation and nutrient losses. Shelterbelts offer a natural, cost-effective, and sustainable solution that works with existing farming systems rather than against them.

🌿 **About our Research**:

Our ongoing research demonstrates that incorporating diverse tree species like Pinus radiata, Macrocarpa, and Willow into pastoral boundaries doesn't just provide livestock shelter; it actively enhances soil health, increases carbon storage, and improves nutrient cycling within grazing systems.

Moreover, our study examined soil health and key functional gene abundance from three commercial farms (two dairy, one beef/sheep) across different distances, soil depths, and seasons, comparing with and without established shelterbelts. Research outcomes will explore how exotic, diverse tree species and mono-species shelterbelts influence nutrient availability, carbon sequestration, abundance of key functional genes of nitrifiers, denitrifiers, bacteria, archaea, and mycorrhiza.

Benefits to whom:
This work contributes to the growing knowledge of farmers and decision makers who are willing to look for nature-based solutions in agriculture.

Funding:
The Ministry of Business, Innovation and Employment (MBIE)—New Zealand

- **Sustainable Agriculture**
- **Soil Health**
- **Shelterbelts**
- **New Zealand Agriculture**
- **Carbon Sequestration**
- **Pastoral Systems**
- **Environmental Science**
- **Nature-Based Solutions**
- **Agricultural Research**
- **Soil Science**

Figure 1: Dishan Amarasinghage taking soil cores to assess the influence of shelter belts on soil properties.

Massey University Soil Society Double Graduation

May 2025 marked a special milestone for the Massey University Soil Society as Secretary Janani Palihakkara graduated with her PhD in Soil Science and President Oliver Arnold completed his Bachelor of Science with a major in Microbiology at the same ceremony, together representing the full spectrum of soil science education from undergraduate to doctoral research.

When Soils Go Underwater: Phosphorus Transformations Uncovered

Dr. Palihakkara's doctoral research investigated phosphorus dynamics across two distinct environments: tropical rice paddies in Sri Lanka under long-term submergence, and temperate critical source areas in New Zealand under short-term submergence. The Sri Lankan component explored phosphorus transformation mechanisms in fertilised soils to understand inconsistent rice yield responses to phosphorus fertilisers. While fertilisers initially released phosphorus within the first week of submergence, concentrations rapidly declined to below detection limits after one week. Modelling indicated this phosphorus was likely re-absorbed onto abundant iron and aluminium oxides, with applied phosphorus moving deeper into the soil profile and transforming into moderately labile fractions.

The New Zealand studies focused on critical source areas in the Manawatū-Whanganui region, investigating phosphorus release during short-term submergence events following rainfall through both controlled glasshouse experiments and field investigations. The field study revealed floodwater from critical source areas containing dissolved phosphorus concentrations 35-43 times higher than target levels for the Manawatū River, particularly concerning given their close proximity to the river system.

These findings provide a foundation for developing precision phosphorus management approaches, including targeted fertiliser placement and slow-release formulations for improved nutrient use efficiency in tropical rice systems. The methodology developed for assessing phosphorus release in temperate soils can be applied across wider critical source areas to inform water quality protection strategies.

Following graduation, Palihakkara has transitioned to investigating toxoplasma oocyst transportation and retention in soils as a Postdoctoral Research Fellow at Massey University, through a Department of Conservation-funded project.

Figure 1: Dr Janani Palihakkara (left) and supervisor Associate Professor Lucy Burkitt (right) at Massey University's May graduation ceremony. Janani also acknowledges the guidance of co-supervisors Dr Jeyakumar Paramsothy and Dr Chammi Attanayake.

Regenerative Agriculture Under the Microscope

President Oliver Arnold represents the next wave of soil biology research, investigating how regenerative agriculture practices influence soil microbial communities in New Zealand pastoral systems. With his microbiology background and current Master's research, Arnold brings a biological lens to questions about sustainable intensification, which is particularly relevant as the sector explores alternatives to conventional management. Although there are some promising results, further monitoring of the soil biology under the different management practices are required to confirm the effects regenerative agriculture has and to elucidate the mechanisms. While he is currently writing up his thesis, his work contributes timely insights into regenerative practices and their measurable impacts on soil biological activity.

Figure 2: Oliver Arnold and fiancée Maddie Cossey celebrating their graduation together.

Canterbury and Otago

Bioeconomy Science Institute (AgResearch)

The recent AgResearch awards showcased some of the great work being undertaken by the Environmental Science teams. The awards recognise outstanding achievement in research quality, relevance, and impact.

The Outstanding Science Award is given in recognition of outstanding achievement in scientific input. This award went to **Richard McDowell** who co-authored the paper with **Dongwen Luo, Peter Pletnyakov, Martin Upsdell** and **Walter Dodds** titled, 'Anthropogenic nutrient inputs cause excessive algal growth for nearly half of the world's population' which was published in Nature Communications in 2025 (www.nature.com/articles/s41467-025-57054-8). The study addresses the challenge of understanding nitrogen and phosphorus impacts on algal growth and establishing reference conditions across jurisdictions, contributing to effective policy settings globally. The findings have been endorsed by global environmental agencies, highlighting their immediate application and alignment to global water quality policy and challenges. The adoption of the research by major food processors and distributors ensures a clear impact pathway and widespread implementation of the findings.

The Impact Prize recognises the achievement of outstanding scientific outputs that deliver or contribute to significant positive sector impacts. Ag:LCA has been awarded the 2025 Impact Prize for its transformative contribution to agricultural sustainability and emissions transparency in New Zealand. The team included **Andre Mazetto**, **Stewart Ledgard, Mark Boyes, Shelly Falconer, Harry Yoswara, Caludio Palmeira** and **Talia Hicks**. Ag:LCA's standardised, science-based methodology – developed by AgResearch – has been independently reviewed and is now recognised by global multinationals and financial institutions. It positions New Zealand as a global leader in low-emissions dairy production and sets a benchmark for how emissions data should be collected, analysed, and used across the agricultural sector. Ag:LCA is now used by 95% of New Zealand dairy farms to generate individual carbon footprints, empowering farmers to take targeted action on emissions reduction and access financial incentives. For example, Fonterra's emissions reduction programme—enabled by Ag:LCA – has unlocked an estimated $51.8 million in annual premiums for farmers who demonstrate emissions excellence. Beyond the farm gate, Ag:LCA is reshaping how major agricultural producers report their carbon footprints to global customers like Nestlé and Mars. By providing accurate, farm-specific emissions data, the Ag:LCA supports compliance with international climate regulations and enhances supply chain transparency.

The Student Award recognises outstanding achievement for high quality relevant research and is awarded to a student based at AgResearch with the foremost science paper that has been accepted for publication within the previous 2-3 years. This year **Keren Ding** was the recipient of this award for her paper titled "In situ nitrous oxide and dinitrogen fluxes from grazed pasture soil following cow urine application at two nitrogen rates". The AgResearch panel found Keren's paper well-written and methodologically rigorous, offering a nuanced understanding of nitrogen cycling in urine-affected soils. It was praised for its innovative use of the 15N technique under field conditions, addressing a significant knowledge gap in quantifying N2 fluxes – a historically understudied process due to measurement challenges. The work's relevance to sustainable pasture management and climate change mitigation, coupled with its good citation impact (11 citations in Scopus as of 26 May 2025), underscored its importance to both agricultural science and environmental policy. The panel particularly commended the study's ability to reconcile contradictory hypotheses about urinary-N effects on denitrification pathways, making it a standout contribution.

Congratulations to these worthy recipients and for showcasing the value of soil science within our research organisation.

Hochstetter lecture 2025 in Waikato

Past, present, and future earthquakes on the alpine fault: what lies beneath and what lies ahead?

Prof. John Townend (Victoria University of Wellington) Public lecture 18th Sept 5pm Room S1.03 (S-block) University of Waikato

The Waikato branch of the Geoscience Society of New Zealand is organising this lecture.

This year's Hochstetter Lecture will review how understanding of the Alpine Fault's earthquake-generating behaviour has developed in recent years, catalysed by novel paleoseismological, geological, and seismological studies including the Deep Fault Drilling Project (DFDP) and the 450 km-long Southern Alps Long Skinny Array (SALSA), and how technological advances such as optical fibre sensing, "virtual earthquakes", and artificial intelligence are providing new insight into fault zone structure and earthquake generation.

The concluding portion of the lecture will address what steps the earthquake science community could take now to record invaluable data during the next Alpine Fault earthquake and thus inform global understanding of earthquake rupture phenomena.

Several decades of painstaking paleoseismological research — using geological measurements to determine the timing and magnitudes of past Alpine Fault earthquakes — have yielded one of the most spatially and temporally extensive paleoearthquake records of any fault worldwide. This record indicates that the Alpine Fault produces large earthquakes on timescales of less than 300 years and that, although the times between one earthquake and the next are remarkably consistent, their inferred sizes vary from depending on which of three sections of the fault rupture at once. More than 300 years have passed since the last major earthquake, in 1717 CE, and the Alpine Fault is thus late in the typical period between successive earthquakes: the likelihood of a magnitude 7 earthquake occurring in the coming 50 years is estimated to be 75%; the odds of that earthquake being larger than magnitude 8 are ~80%.

Scientific drilling studies reveal that the Alpine Fault is also unusually hot, at least along its central section near Aoraki/Mt Cook where the most rapid uplift of the Southern Alps is occurring and where long-term slip rates are the highest. Variations in temperature along the length of the Alpine Fault have since been found to affect the distribution of present-day low-magnitude seismicity and deep aseismic creep, and are likely to influence patterns of slip in future large earthquakes.

Despite substantial advances in understanding the Alpine Fault's past and present-day seismicity, how and where the fault will slip in a future earthquake and what groundshaking will result are difficult to anticipate without knowing which of many geologically- and geophysically-plausible scenarios eventuates.

Conferences

23rd World Congress of Soil Science

This esteemed event will take place in Nanjing, China, from June 7 to June 12, 2026, and we eagerly anticipate your participation in this international gathering. Theme: 'Soil and the Shared Future for Humanity'.

Since its inception in 1927, the World Congress of Soil Science has been convened every four years, serving as a pivotal scientific forum in the realm of soil sciences. The Soil Science Society of China won the bid in 2018 to organize WCSS2026 in Nanjing.
https://www.23wcss.org.cn/

Abstract Submission Opens: Monday, July 7, 2025
Abstract Submission Deadline: Friday, November 7, 2025

International Conference on Geomorphology

Invitation to submit abstracts to the International Conference on Geomorphology, Christchurch, 2-6 February 2026.

We look forward to welcoming you to Christchurch New Zealand for the International Conference on Geomorphology in 2026. Tectonically-active, in the 'Roaring 40s' and geologically-young, Aotearoa New Zealand offers world-class geomorphology with some of the world's fastest rates of uplift and erosion.

https://www.confer.co.nz/icg2026/

Geomorphology in New Zealand

- Tectonically-active, in the 'Roaring 40s', geologically-young: Aotearoa New Zealand offers world-class geomorphology.
- Some of the world's fastest rates of uplift and erosion.
- A remarkable record of Quaternary and historical landscape changes.
- A strong history of geomorphological research.
- From the active volcanoes and mountains, along the dynamic and braided rivers, and out to the diverse coastal environments, there is something exciting for every geomorphologist!

We look forward to seeing you in 2026.

Abstracts

Ledgard SF, Ryan B, R. SM, Amanda J, Magdalena B, Geoffrey B, and Somchit C 2025 Nitrogen leaching from dairy farms on volcanic soils under high rainfall and effects of mitigation with gibberellic acid targeted to urine patches using Spikey® technology. New Zealand Journal of Agricultural Research On-line early. https://doi.org/10.1080/00288233.2025.2507864

Nitrogen (N) leaching from grazed pastures occurs predominantly from animal urine. Several mitigation options have been developed. In this study we investigated application of gibberellic acid directly to urine patches only, after grazings using Spikey® targeted technology. This was tested over three years in two farm studies, near Rotorua and Stratford, on volcanic soils under high rainfall (>2000 mm annually). Previous New Zealand grazing N leaching studies have all been in low-medium rainfall (600-1400 mm yr^{-1}) environments. The Rotorua farm study used large paired-plots within paddocks (8 replicates), with Spikey®-GA treatment on one of each pair after all grazings. Pasture yield assessments using a rising-plate-meter indicated a 7-14% higher average pasture mass to Spikey®-GA at this site. There was no effect of Spikey®-GA treatment on N leaching (measured using 320 ceramic cup samplers) in all years. The Stratford study had separate Control and Spikey®-GA farmlets. It showed no significant effect of Spikey®-GA on pasture production but had significantly lower ($P < 0.05$) nitrate-N concentrations in leachate during late-winter/spring in the first two years and the same trend in the third year. Over three years, nitrate-N leaching averaged 38.1 and 30.9 kg N ha^{-1} yr^{-1} ($P < 0.05$) in the Control and Spikey®-GA treatments, respectively.

Tamepo RL, Crile D, and McDowell RW. 2025. Are there clear benefits from diversification of land use: a review and preliminary meta-analysis? Journal of the Royal Society of New Zealand: On-line early. https://doi.org/10.1080/03036758.2025.2496373

Diversified farming systems are often considered more resilient and environmentally sustainable than monocultures. However, their performance on key environmental and economic outcomes remains poorly defined across different contexts. We reviewed the literature and examined data from 277 sites, primarily in New Zealand, regarding the merits of land-use diversification. We tested the hypothesis that nitrogen (N) and phosphorus (P) losses to freshwater (kg/ha), greenhouse gas (GHG) emissions, and job creation differ between farm and catchment scales and that diversification can reduce these environmental losses. Our findings indicate that, contrary to expectations, N losses were higher in diversified systems compared to monocultures at farm scale, and catchment scale. This increase was largely attributed to land-use changes and cultivation practices. However, the total number of jobs was higher in diversified systems at both scales. Although heavily context-dependent, these observational data provide a rationale to determine the conditions under which diversification can improve environmental and economic outcomes. Beyond biophysical conditions, additional challenges in implementing diversification lie in the phasing and implementation of catchment policies at the farm scale, robust supply and value chains to adapt to market demands, and the need to develop and implement technology fit for varied (and diversified) farm systems.

Mudge PL, Glover-Clark GL, McNeill SJE, Dewhurst Z, Penny V, Rau J, McKay E, Hedley CB, Eger A, Fraser S and others 2025. Design and results from a national soil carbon stock benchmarking and monitoring system for agricultural land in New Zealand. Geoderma 459: 117354. https://doi.org/10.1016/j.geoderma.2025.117354

Despite the importance of soil organic carbon (SOC) stocks and stock changes, few countries are monitoring changes through time with direct soil measurements. National-scale changes of SOC stocks in New Zealand's mineral soils, reported to meet international requirements, are currently predicted based on transitions of land use using a statistical model calibrated with historic data. However, historical data were often originally collected for purposes other than SOC monitoring and are not fully spatially representative and the current model is also based on the assumption that SOC stocks do not change through time, if land use does not change. Here, we outline the design and report benchmark results from New Zealand's National Soil Carbon benchmarking and Monitoring programme (NSCM), where 504 sites were established to determine a robust baseline of SOC stocks for agricultural land in New Zealand, with spatially representative sampling across five broad land use classes. Mean slope-corrected SOC stocks for the 0–30 cm layer for all agricultural land on mineral soils in New Zealand were 101.3 $Mg.ha^{-1}$, and 138.2 $Mg.ha^{-1}$ for the 0–60 cm layer. SOC stocks in the 0–30 cm layer were highest under dairy pasture (110.7 $Mg.ha^{-1}$) followed by hill country drystock pasture (104.3 $Mg.ha^{-1}$), flat-rolling drystock pasture (98.7 $Mg.ha^{-1}$), perennial horticulture (84.8 $Mg.ha^{-1}$) and lowest under cropland (80.1 $Mg.ha^{-1}$). Differences between land uses could not be attributed to land use alone, as the location of different land uses is often related to soil type and climate. Results provide spatially representative data that will feed into national soil carbon inventory reporting and is a crucial baseline against which to compare future sampling to determine if SOC stocks are changing in New Zealand's agricultural land.

de Sousa Mendes W, Roudier P, Mudge PL, McNeill SJE, Goodrich JP 2025. Comparison of different approaches for estimating profile soil organic carbon stocks from topsoil samples. Geoderma 460: 117404. https://doi.org/10.1016/j.geoderma.2025.117404

Changes in land use, management, and climate can significantly influence soil organic carbon (SOC) dynamics, prompting domestic and international initiatives to prioritise monitoring, reporting, and verifying SOC stock changes. Based on the greater availability of surface soil carbon samples, this study aims to assess the feasibility of estimating SOC stocks at deeper depths using topsoil samples. Both parametric and non-parametric techniques (Bayesian regression), quantile regression forests, and generalised additive models were tested to predict SOC stocks from topsoil samples (defined for either fixed or variable depths) and for different profile depths (0-30 cm and 0-60 cm). The best predictions were obtained using generalised additive models that accommodate different topsoil depths. This approach eliminates the need to harmonise topsoil depths prior to modelling. Predictions for 0-30 cm (RMSE = 14.29 $Mg\cdot ha^{-1}$, MEC = 0.72, CCC = 0.83) were more accurate than those for deeper soil depths (0-60 cm; RMSE = 24.87 $Mg\cdot ha^{-1}$, MEC = 0.60, CCC = 0.74). While those uncertainties are still substantial, these results demonstrated the potential of using surface soil samples to complement existing SOC datasets.

McNally S, Pronger J, Goodrich J, Allen K, Graham S, McNeill S, Roudier P, Norris T, Barnett A, Schipper L, Mudge P 2025. Reconciling historic and contemporary sampling of soil organic carbon stocks: Does sampling approach create systematic bias? Geoderma 458: 117338. https://doi.org/10.1016/j.geoderma.2025.117338

Changes in land use, management, and climate can significantly influence soil organic carbon (SOC) dynamics, prompting domestic and international initiatives to prioritise monitoring, reporting, and verifying SOC stock changes. Based on the greater availability of surface soil carbon samples, this study aims to assess the feasibility of estimating SOC stocks at deeper depths using topsoil samples. Both parametric and non-parametric techniques (Bayesian regression), quantile regression forests, and generalised additive models were tested to predict SOC stocks from topsoil samples (defined for either fixed or variable depths) and for different profile depths (0-30 cm and 0-60 cm). The best predictions were obtained using generalised additive models that accommodate different topsoil depths. This approach eliminates the need to harmonise topsoil depths prior to modelling. Predictions for 0-30 cm (RMSE = 14.29 $Mg\cdot ha^{-1}$, MEC = 0.72, CCC = 0.83) were more accurate than those for deeper soil depths (0-60 cm; RMSE = 24.87 $Mg\cdot ha^{-1}$, MEC = 0.60, CCC = 0.74). While those uncertainties are still substantial, these results demonstrated the potential of using surface soil samples to complement existing SOC datasets.

Giltrap Donna L., Saggar Surinder, Berben Peter, Palmada Thilak (2025) Are fans required for closed chamber N2O measurements in grazed pastures?. Soil Research 63, SR24216. https://doi.org/10.1071/SR24216

Static chambers are the most common method for measuring nitrous oxide (N_2O) and other greenhouse gas fluxes from soils in field conditions. However, there are no definitive guidelines on the use of fans to improve the mixing of air within chambers during sampling. In this study, we compared N_2O fluxes following the application of a range of urine and nitrification inhibitor treatments to pasture soils using large (0.5 m^2 footprint) static chambers both with and without the use of fans. Measurements were taken with and without fans from two experiments, each using a total of 56 chambers. In one of these experiments, the measurements were made at a time of low N_2O fluxes, while in the other experiment, measurements were made at a time of high N_2O fluxes. Overall, both regression models and non-parametric methods found negligible effect of fan use on N_2O measurements, although there could be a slight under-estimation of fluxes measured without fans under low emitting conditions. However, these results might not hold for systems with taller chambers containing more plant biomass or shorter measurement intervals.

Li J, Hu W, Langer S, Malcolm BJ, Maley S, Jenkins H, Carey P 2026. Catch crops promote soil physical recovery after forage crop grazing. Soil and Tillage Research 255: 106778. https://doi.org/10.1016/j.still.2025.106778

Soil compaction-induced physical degradation is a threat to sustainable crop production and environmental performance. While measures have been evaluated to alleviate compaction, the impact of catch crops establishment on soil physical recovery following winter grazing remains underexplored. Six New Zealand trials over different years investigated: (1) the effects of soil compaction induced by winter forage crop grazing on soil health, and (2) the effectiveness of catch crops establishment in facilitating soil recovery. Our findings revealed that winter grazing resulted in significant soil physical degradation in the top 10 cm, evidenced by significant reduction in total porosity, macroporosity, available water content, saturated hydraulic conductivity (Ks), and soil quality *S* index. The degree of soil degradation was higher under increased grazing intensity (fodder beet grazing compared with kale grazing) and wetter conditions. For example, in Te Pirita-2019 with kale, changes in Ks were not significant. However, in Te Pirita-2019 with fodder beet, Ks decreased significantly from 1548 mm day^{-1} to 88 mm day^{-1}, representing a 94.3 % reduction. Compared with fallow after grazing, growing catch crops promoted soil restoration. Conventional moldboard ploughing and the recently introduced single-pass ‘spader-drill’ outperformed direct drill for soil recovery. This study highlighted the importance of catch crop establishment using conventional tillage and spade drill to mitigate soil degradation resulting from winter forage crop grazing. The spader-drill, where soil conditions allow, is preferred because it allows earlier sowing of catch crops, leading to broader benefits such as increased crop biomass and reduced nitrogen leaching.

McDowell RW, Luo D, Pletnyakov P, Upsdell M, Dodds WK 2025. Anthropogenic nutrient inputs cause excessive algal growth for nearly half the world’s population. Nature Communications 16(1): 1830. https://doi.org/10.1038/s41467-025-57054-8

Reference conditions pertain to conditions without anthropogenic influence and serve to gauge the degree of river pollution and identify the best attainable water quality. Here we show estimates of the global human footprint of nitrogen and phosphorus concentrations and potential for related nuisance or harmful algal growth in rivers. We use statistical models based on 1.2 million stream nutrient measurements (from 2005 to 2013) and find global human enrichment of river total nitrogen and total phosphorus is 35% and 14% respectively. The greatest enrichment is in Europe (86 and 30% respectively) and the least in Oceania (9 and 2% respectively). The levels of enrichment translated into an almost doubling of the catchment areas with rivers predicted to have anthropogenically elevated levels of potentially harmful or nuisance algae, affecting ~40% of the world's population. Focusing management on the difference between current and reference conditions can help protect good water quality while avoiding unrealistic goals where nitrogen and phosphorus are naturally high.

Kleinman PJA, Flaten D, Osmond D, Jarvie H, McDowell R, Simpson Z, Mott J 2025. Through the lens of phosphorus: The legacy of Andrew Sharpley. Journal of Environmental Quality 54(4): 763-769. https://doi.org/10.1002/jeq2.70032

The pursuit of sustainable phosphorus (P) management represents a long-standing challenge in agricultural arenas, with far-reaching implications for the environment and societal development. Few scholars are as synonymous with P science as Andrew Sharpley. Renowned over his 44-year professional career for providing foundational insights into the fate and management of agricultural P, Sharpley also became the central figure in organizing responses to concerns over the contribution of non-point source P pollution to eutrophication. As a global authority, Sharpley led teams that crafted scientific consensus for use by managers and policymakers in the face of complexity and uncertainty. His leadership offers lessons to those continuing in his footsteps and a model for all who desire to achieve scientific impact. This special collection of papers celebrates the perspectives, contributions, and legacy of Andrew Sharpley.

McDowell R, Kleinman PJA, Haygarth P, McGrath JM, Smith D, Heathwaite L, Iho A, Schoumans O, Nash D 2025. A review of the development and implementation of the critical source area concept: A reflection of Andrew Sharpley's role in improving water quality. Journal of Environmental Quality 54: 807-826. https://doi.org/10.1002/jeq2.20551

Critical source areas (CSAs) are small areas of a field, farm, or catchment that account for most contaminant loss by having both a high contaminant availability and transport potential. Most work on CSAs has focused on phosphorus (P), largely through the work in the 1990s initiated by Dr. Sharpley and colleagues who recognized the value in targeting mitigation efforts. The CSA concept has been readily grasped by scientists, farmers, and policymakers across the globe. However, experiences and success have been mixed, often caused by the variation in where and how CSAs are defined. For instance, analysis of studies from 1990 to 2023 shows that the proportion of the annual contaminant load coming from a CSA decreases from field to farm to catchment scale. This finding is consistent with increased buffering of CSAs and greater contribution of other sources with scale, or variation in the definition of CSAs. We therefore argue that the best application of CSAs to target mitigation actions should be at small areas that truly account for most contaminant loss. This article sheds light on the development and utilization of CSAs, paying tribute to Dr. Sharpley's remarkable contributions to the improvement of water quality, and reflecting upon where the CSA concept has succeeded or not in reducing contaminant (largely P) loss.

Deadline....... for the next issue of Soil News is 10 November

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