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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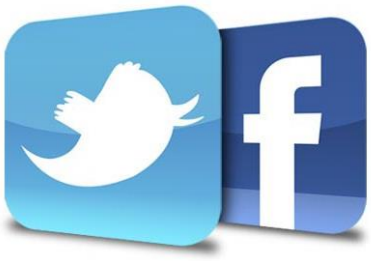

Have you liked us on Facebook? The NZSSS has a Facebook page and Twitter handle (@NZ_Soil_Soc). If you are already a user, please follow us. You can also keep an eye out for new NZSSS posts by checking the feed from our website

Officers of the NZSSS December 2022-2024

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Vice President: Diana Selbie (AgResearch)
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Editorial - Science cutbacks and changes

Welcome to this issue of Soil News.

Science cutbacks to staff numbers and funding are occurring in many science organisations, Crown Research Institutes, universities, and the government sector. Scientists and researchers throughout the agricultural and general science sectors now have less funding available.

Cutbacks in the science sector have been summarised in a recent report by 'Save Science Coalition'. The Save Science Coalition is a group of organisations including unions and scientific societies with an interest in ensuring that Aotearoa New Zealand has a well-functioning and well-funded science and research system.

A public report by Save Science Coalition shows between 349 and 359 science roles had been lost or were proposed to be removed. The report shows further reductions over the next four years in the Strategic Science Investment Fund, Endeavour and Marden Funds, with other reductions also listed. In addition, funding of about $64 million a year, is becoming unavailable with the planned ending of the National Science Challenges. After 30 June 2024, funding for the 11 National Science Challenges ends. The Science Challenge areas received a total of $680 million since they were set up a decade ago.

Links, including to their report
https://scientists.org.nz/Save-Science-Coalition?emulatemode=2
https://scientists.org.nz/resources/Documents/PressReleases/SSC_press_release_May30update.pdf

Change is inevitable. Science cutbacks and changes are not new to some New Zealand soil researchers and our soil-based universities and CRIs. On a personal note, I started a soil science career in the mid-1990s. Back then and since, I was aware of CRIs with redundancies occurring, skills lost, cuts, reprioritising, and closing research centres etc.

Reprioritising funding and research have had many benefits as well, with some good funding, opportunities, knowledge, great science achieved, and evolving careers in many areas. Some areas of soil science have had reduced resourcing on the journey, but some years later became well-resourced, e.g. carbon modelling and research, and soil mapping and research – due partly to new global science, changing priorities, and adaptable, very talented and persistent people. No doubt other examples experienced by Soil News readers.

Much has been written in the media at the time of such changes, including commentary from farmers, agricultural industry organisations and extension, researchers, plus public and media campaigns to keep several regional agricultural science centres open. I can recall several in Southland and Otago, with Gore Research Station closing during the 1990s and Woodlands Research Station (the other Southland option at the time but remained open, but again in question in late 2023 according to the Southland media), plus reduced staffing at the Invermay Agricultural Centre (numerous articles in the media at various times). There were other examples in the media.

Various articles have been written over the years, including opinions and aspects of the New Zealand science system, its evolution and development since the late 1980s, and its tension with the commercial model (e.g. Edmeades 2004). Other articles are more specific, for example, recently Doole et al. (2023) reports how reductions in the numbers of research farms over the last 30 years have impacted on the delivery of agricultural science.

More change is coming. Recently in the media, the possibility of large cutbacks in GNS staff was announced. A Science System Advisory Group (SSAG) has been established by the Ministry of Business, Innovation and Employment to provide advice to the government on strengthening the science, innovation and technology system. The University Advisory Group (UAG) has been set to provide the government with advice on New Zealand's university system. Further information is available: https://ssag.org.nz/

The current changes are the largest I have seen, or am likely to see, in 30 years of being in soil and environmental science. For now though, I'm optimistic for the future, if good, well-considered, long-term decisions are made, rather than for short-term gain.

John Drewry

Disclaimer: any opinions expressed are those of the writer only. Most of the information has been, or is, in the public domain or media.

References

Doole G, Tozer K, Sauermann C, Stevens D, Ward J 2023. Challenges and opportunities for conducting on-farm research. Journal of New Zealand Grasslands 85: 83-91. https://doi.org/10.33584/jnzg.2023.85.3659

Edmeades D 2004. Is the commercial model appropriate for science? New Zealand Science Review 61(3-4): 85-92.

New Zealand Society of Soil Science and Soil Science Australia Joint Conference

Save the date! The Joint New Zealand-Australian Soils Conference is coming to Rotorua, 2-5 December 2024.

The organisation committee is already busy to try and make sure this edition will be the most successful to date.

We need your help!

As part of this effort, your help is needed: the Science Program Committee is looking for help to review the abstracts and contribute to the high-quality standard of the scientific program of the conference.

Please contact Pierre Roudier (roudierp@landcareresearch.co.nz) or Sam Carrick (carricks@landcareresearch.co.nz) if you are interested to take part.

Abstract submissions extended until 30 August

Due to many extension requests received, we have extended the submission deadline until 30 August 2024, 11pm. Make the most of this only extension deadline!

We welcome a broad range of abstracts around our conference theme “Weaving Soil Science Across Cultures & Environments”.

Individual (*oral and poster*) submissions are invited in the following subject areas (themes):

- Development & implementation of soil and land policy
- Soil security
- Soil Monitoring
- Degraded soils, their effects, and rehabilitation
- The role of soil in human health and well-being
- The value of urban soils
- Erosion
- Applied agricultural soil management
- Sustainable forestry soils
- Soil biology & biodiversity
- Soil biogeochemistry
- Soil physics
- Soils in a changing climate
- Technological advances in lab and field measurement
- Pacific islands soil management
- Soils in the landscape
- Soil data and information systems
- Soil science education, outreach and professional development
- Integrating indigenous soil knowledge

Please submit an abstract only if you intend to attend and present your abstract in person.
For submission instructions and guidelines, please click here

Soil Judging Competition

The New Zealand Society of Soil Science, Manaaki Whenua – Landcare Research, and Lincoln University are organising an international Soil Judging Competition to bring together students, early career and experienced soil scientists and professionals for a celebrated professional development event.

We invite you (and your organisation) to enter individually or as a team in the 2024 Moana Oceania Soil Judging Competition from 28th November – 1st December in Rotorua, New Zealand. The event is being held in conjunction with SOILS ROTORUA 2024, the joint NZ-Australia Soil Science Conference, which takes place immediately afterwards, on the 2nd - 5th December 2024.

The competition requires teams and individual team members to correctly identify soil features, classify soil profiles, and interpret soil capability. The first two days are aimed at teaching and familiarising participants with soil judging and the third day is a competition day. This event is one of the best practical training and networking opportunities for aspiring soil professionals. You will learn alongside students, early career and experienced soil scientists, and soil enthusiasts, from New Zealand, Australia, and beyond!

No prior experience required. **ENTRIES ARE OPEN**

Registration fee: $50 per person
Entry is open to any student or professional interested in soil science.

Click here to see save the date flyer for more information, or
visit https://www.soilscience.org.nz/sjc

Help needed to review abstracts

NEW ZEALAND SOCIETY OF SOIL SCIENCE AND SOIL SCIENCE AUSTRALIA JOINT CONFERENCE

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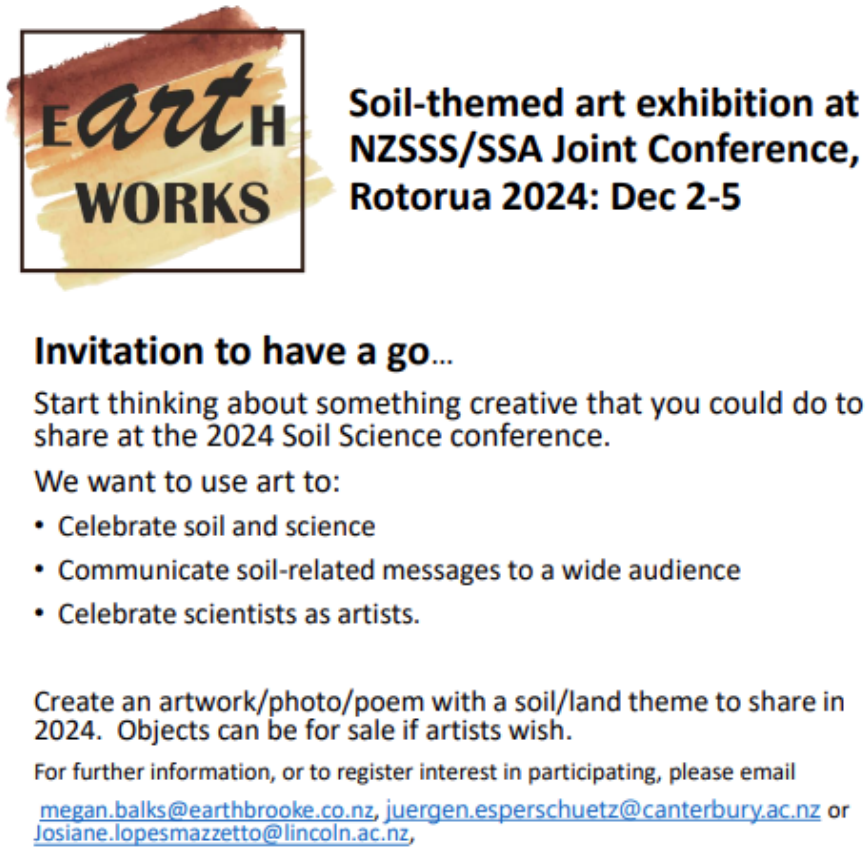
The organising committee

Soil-themed art exhibition

At NZSSS/SSA joint conference, Rotorua 2024: December 2-5



For further information, or to register interest in participating, please email megan.balks@earthbrooke.co.nz, juergen.esperschuetz@canterbury.ac.nz or Josiane.lopesmazzetto@lincoln.ac.nz

2024 NZARM Conference

The 2024 NZARM Conference is being held in Palmerston North on the 12-14th of November.

Location: Conference Centre, Main Street, Palmerston North
Register here: https://oncue.eventsair.com/nzarm2024/registration
Get in touch: *nzarm2024@horizons.govt.nz*

Further information
NZARM Conference 2024: NZ Association of Resource Management

Photo credit: https://nzarm.org.nz/capability-building/conferences/conference-2024

Dr Brent Clothier's farewell as president of the Royal Society Te Apārangi Council

In June 2024 the Royal Society held a function to honour out-going President Dr Brent Clothier FRSNZ and to unveil a portrait of him by Freeman White (see photo).

Brent has served on the Royal Society Te Apārangi Council as President for three years and as President-Elect for a year before that, but his association with the Society goes back many years. He was elected a Fellow in 1994 and has served on the Marsden Fund Council, among many other roles.

Those gathered had the pleasure of hearing warm stories from his whānau, friends, colleagues and kaimahi at the Society. These included recollections from his daughters about growing up in a household with a committed soil scientist as a father! All who spoke noted Brent's astuteness as well as his enthusiasm, optimism and kindness. Ngā mihi nui ki a koe, Brent.

Photo: Out-going President Dr Brent Clothier FRSNZ and a portrait of him by Freeman White, also pictured.

Credit: Information and photo from Royal Society Te Apārangi ‘Alert’ newsletter Issue #1284, 27 June 2024. Further photos: President Dr Brent Clothier Farewell 2024 - Google Photos
(Further information in ‘News from the Regions’ below).

News from the Regions

Waikato/Bay of Plenty

Lincoln Agritech Ltd

LuWQ 2025
Roland Stenger, Principal Scientist in our Environmental Research Group, is excited to serve once again on the Scientific Advisory Group for the Land Use and Water Quality series of conferences. Scientists and land and water managers from Aotearoa New Zealand had an exceptionally strong presence at earlier conferences, particularly in 2017 (The Hague, NL) and 2019 (Aarhus, DK), but due to Covid-19 restrictions missed out in 2022 (Maastricht, NL). Given the success of previous events, Roland hopes that next year's conference in Aarhus, Denmark, will allow many previous participants to reconnect, and new ones to establish ties with the international Land Use and Water Quality community. For details, please see https://www.luwq2025.nl/.

University of Waikato

Louis Schipper was invited to give a keynote address at the 9th International Symposium on Soil Organic Matter in Morocco entitled "Soil organic matter: Maintaining soil quality and managing greenhouse gas contributions in New Zealand". Held at the Mohammed VI Polytechnic University in Ben Guerir. It was an incredibly diverse conference with Africa and many other parts of the world were well represented. There was stark contrast between New Zealand's soils rich in organic matter and many African soils with often less than 1% carbon. The ability to access fertiliser for additional food production can be a major challenge. Further, some of these soils are so low in organic matter that there was no/little response to addition of fertiliser. But it was clear that there is massive potential and talented, passionate people striving to make real difference.

Figure 1. The 9th International Symposium on Soil Organic Matter in Morocco. Lower left are conference organisers Professors Joann Whalen and Ngonidzashe Chirinda.

David Lowe took part in the most recent “Resilience Forum” run by Waikato Regional Council (WRC) held at the National Velodrome facility near Cambridge on Friday 9 August (Figure 2; left). The forum was similar to earlier events focussed on hazards but with a slight twist in emphasis to include resilience as well as identifying and mitigating hazards. With close to 70 participants, the event (well coordinated by Lauren Empson, Figure 2; right) was the largest held by WRC. The day involved a wide range of presentations including impacts of climate change, modelling work, and the development or upgrading of new online hazard tools. A panel discussion on adaptations to hazards and risks also took place. Many of these topics are relevant to soils and land use planning.


Figure 2. View of velodrome as seen from the forum's meeting room (left image) and Lauren Empson starting the resilience forum (right image).

Alongside short reports by others at the University of Waikato encompassing aspects of planning as well as various natural hazards, David (now an honorary professor, having retired after 18 June 2024) gave an update on results from projects involving trenching across the newly discovered Te Puninga Fault near Morrinsville (reported in an earlier *Soil News*) and from the main paleoseismology project he helped to lead from 2019 using liquefied tephra layers in lake sediments (called tephra seismites) to work out the past earthquake history for the Hamilton Basin (see https://tephra-seismites.com/).

David reported that spatial and temporal analysis of 161 cores extracted from 18 lakes, all of which were scanned using CT imaging at Hamilton Radiology, had revealed four earthquake events had taken place (causing lacustrine tephras to liquefy) since c. 15,600 years ago, ranging from around 5.5 to 7.5 in magnitude (Mw). The first two events were on the Te Puninga and/or Kerepehi faults in the Hauraki region, the third was on the newly discovered Kukutaruhe fault that runs north-south through the middle of Hamilton City, and a fourth event, taking place remarkably within the last 1700 years (since emplacement of Taupo tephra), was generated by an unknown fault near Te Awamutu in the southeastern part of the Hamilton Basin.

Manawatu

Plant & Food

Royal Society Te Apārangi

At the end of June, Brent Clothier completed his three-year tenure as President of the Royal Society Te Apārangi. Brent has been the first CRI-based President of the Royal Society, although Trevor Hatherton of DSIR's Geophysics Division was President between 1985-1989. Trevor was the previous Government-based scientist to lead the Royal Society Te Apārangi. The RSNZ tradition is to commission a portrait of the departing President, and Brent's was unveiled during the last week of June, and his PFR bosses joined in the celebration at Te Whare, Royal Society Te Apārangi on 25th June.

Brent Clothier, the ‘retiring’ President of the Royal Society Te Apārangi, along with Paul Johnstone (General Manager, Sustainable Production, PFR), Roberta Gentile (Team Leader, Land Use Impacts, PFR), Brent’s portrait, Brent, and Mark Piper (Chief Executive, PFR).

Gansu Province, China

In July, Brent Clothier was invited to Wuwei City in the Hexi Corridor of Gansu Province in the northwest of China to attend the 20th celebration of China Agricultural University’s (CAU) National Field Scientific Observation and Research Station on Efficient Water Use of Oasis Agriculture, also known as the Shiyanghe Research Station. The celebration encompassed a symposium on agricultural water conservation and efficient utilisation of water resources in the Shiyang River Basin. There were nearly 400 attendees at the Symposium, along with the President of CAU, and 12 Academicians, including Brent who is an Academician (International) of the Chinese Academy of Engineering.

The attendees of the 6th Shiyanghe Forum during July 22-27th, 2024 in Wuwei City. In the spirit of “Where’s Wally?”, Brent is located somewhere in the front right!

At the Symposium, Brent was able to catch up with 3 Associate Editors of the journal *Agricultural Water Management*, on which Brent is Editor-in-Chief. The photo below shows Brent with Associate Editors Prof. Rangjian Qiu (Wuhan University) and Prof. Xiaomin Mao (China Agricultural University). He also caught up with Associate Editor Prof. Taisheng Du (CAU) in Wuwei City but didn't get a photo!

Beijing Forestry University, China

After the meeting in Gansu, Brent spent time with Prof. Xi Benye of Beijing Forestry University (BJFU), and some of his PhD students. The photo below shows Brent with Xi (centre) and some of his students sharing a 'hot-pot' meal in Beijing with pijiu and baijiu. Brent has an adjunct appointment at BJFU and co-supervises three students there, the two on the left, Xiaoning Zhao and Lingya Li, along with Yang Liu (second from right)

Manaaki Whenua – Landcare Research

Farewells

Garth Harmsworth retires after 41 years

Garth Harmsworth (Te Arawa-Waikato-Tainui, Ngāti Tūwharetoa, Tūhourangi, Ngāti Raukawa) retired on June 30 2024, after being in the science system in Aotearoa for ~41 years.

Garth was Principal Scientist (Environmental Planning, GIS applications, Māori research and issues) at Manaaki Whenua. Garth says “since the early 1980's it has however been a turbulent ride of highs and lows”, and indicted if the science funding system was well funded and stable he might have lasted a bit longer. Garth left with “a tinge of sadness, rather than celebration”.

Garth grew up in Rotorua amongst the steam, mudpools, geysers, lakes, and ngahere. From a large extended Māori family (his iwi affiliations are central North Island, Te Arawa, Ngāti Tūwharetoa, Ngāti Raukawa, Tūhourangi), he was exposed to Māori culture from an early age, on a daily basis (and unfortunately alot of racism). His uncle was the first Māori race relations conciliator in Aotearoa-New Zealand, just after the Waitangi Tribunal (Te Tiriti Act 1975) was established. On leaving school he went to University of Waikato to study earth sciences and botany. He studied under excellent internationally renowned scientists and

lecturers and went onto graduate in earth science across geology, sedimentology, geomorphology, and soil science.

He says “I was part of a team that produced the first geology map of the Tauranga basin (partly based on my research of stratigraphy, geochemistry and chronological dating and naming of distal pyroclastic flows and tephras)”.
From University, Garth went onto work at DSIR geological sciences analysing fluvial and volcanic deposits, then a short stint with Ministry of Energy Wellington, then to the Ministry of Works science centre in Palmerston North. After restructuring in the mid 1980’s it became DSIR Land Resources, and then restructuring again to become the CRIs, Manaaki Whenua in 1992 and to our present site at Massey, Palmerston North in 1994.

His work in Palmerston North concentrated on land resource mapping, the NZLRI and the LUC mapping and classification system, soil landscape modelling, soil health, integrated catchment management, Māori values classification and mapping, and the development of spatial information systems, GIS, and databases. Since starting with DSIR a strong theme of Garth’s work has been driving te ao Māori (Māori world view, perspectives) and Māori knowledge (mātauranga Māori, understanding, concepts) through all aspects of my research projects. This gradually grew and grew to take over all his projects, using both the skills of western science on the one hand, and mātauranga Māori on the other. Garth says this goes back to his family upbringing in Rotorua and those who influenced him.

Garth has several presentations which provide a glimpse of the breadth of his work:
MfE freshwater management and te ao Māori (Te Mana O Te Wai)
https://vimeo.com/740130858/a14d5102ef
COP 26 (about 50 minutes in) Connecting with earth - soil health
https://www.youtube.com/watch?v=CKNahjOtixw
Talk at the Royal Society of New Zealand
https://www.youtube.com/watch?v=s7h6RDBhsQ4
Further information:
https://www.landcareresearch.co.nz/partner-with-us/science-and-matauranga-maori/
Research gate: https://www.researchgate.net/profile/Garth_Harmsworth

(Text provided by Garth, adapted by editor and approved by Garth for use in Soil News).

Photo: Holden Hohaia (left) and Garth Harmsworth (right) at his farewell. Photo: Nic Faville

Gautam Shrestha received a post-doctoral appointment at AgResearch, Palmerston North. Gautam completed a PhD with MWLR and Massey University supervisors, and he's been working in our soil labs on a causal basis. We're very pleased for Gautam – to see his persistence rewarded at a time when CRIs are not hiring widely. He's also published a recent paper from his PhD, 'Predicting cadmium fractions in agricultural soils using proximal sensing techniques', (see abstracts section).

John Triantafilis left us in late June to return to Sydney. John has been our portfolio leader for the Managing Land and Water portfolio. During the time he has been with us, John has also enlightened us on proximal sensing, digital soil mapping, new ways of spatially evaluating soil nutrients, new ways of looking at data, and supporting a post-doc position. John and colleagues have been working on proximal sensing and laboratory data from the Lincoln University Dairy Farm. John adopted the Palmerston North office as his home base and had lots of enthusiasm for soil research ideas and supported the team involved.

Dr Yuxin Ma joined Manaaki Whenua - Landcare Research in February 2020 as a pedometrician in the Land Use and Ecosystems team based in Palmerston North. During her time with us, she contributed to projects on soil spectroscopy (including the development of a soil spectral library for New Zealand), incorporating soil

knowledge into machine learning techniques, and modeling greenhouse gas fluxes from soils. Her work has been internationally recognised, earning her the Dan Yaalon Young Scientist Medal from the International Union of Soil Sciences in 2022 and the Margaret Oliver Award from the Pedometrics Commission of the International Union of Soil Sciences in 2023. Yuxin will be leaving MWLR in mid-August, and we wish her all the best in her future endeavours.

Benny Theng celebrates the launch of his textbook revised after 50 years!

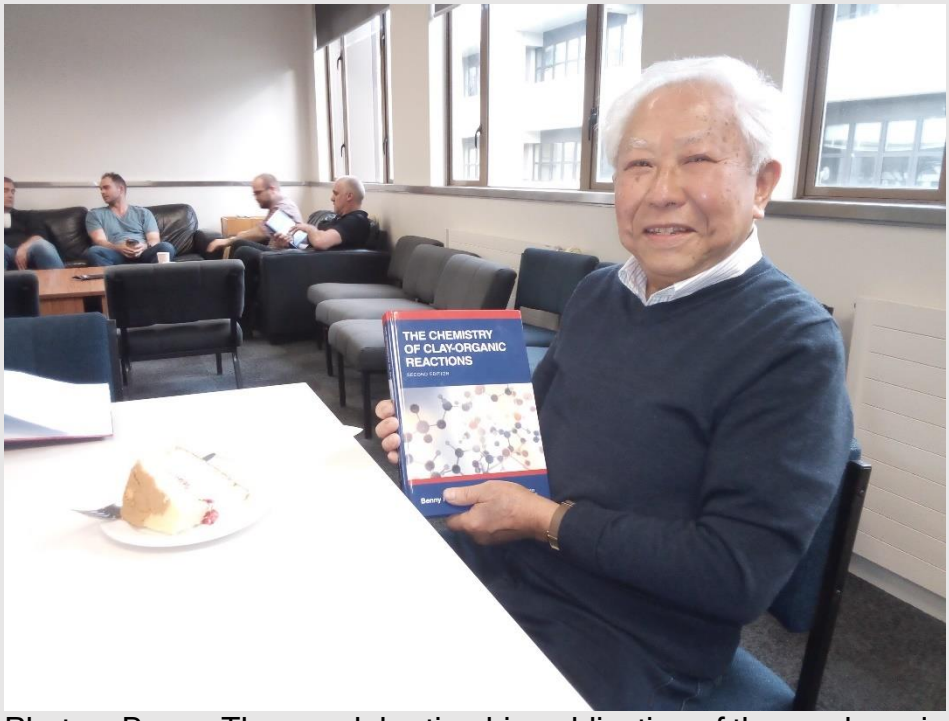
Congratulations to Benny Theng on the publication of the newly revised edition of his 1974 textbook 'The Chemistry of Clay-Organic Reactions'. The Palmerston North office celebrated with him in June.

Benny says "The first edition of *The Chemistry of Clay-Organic Reactions*, published in August 1974 by Adam Hilger (London, UK), was awarded the Adam Hilger Prize and has received more than 2100 citations. The idea of revising the book was suggested by many colleagues as much new information on the clay-organic interaction has since come to light. It was not until I began to search the relevant literature, however, that I realized the extent to which the discipline has developed and grown over the past four or so decades in terms of quantity, quality, and diversity".

Benny goes on to explain "The primary objective of writing a second edition, therefore, is to update the data and information contained in the first edition. The general arrangement of the contents in the 1974 edition has been retained. However, the chapter dealing with clay-catalysed organic reactions has been omitted since this topic has recently been reviewed (Theng 2018). Instead, there is a chapter on the interactions of clay minerals with negatively charged organic species, and one dealing with organic complexes of layer-ribbon and short-range order silicates. Following the format of the first edition, each chapter here is presented as a self-contained, critical review with its own complement of references to the published literature".

Reference
Theng, B.K.G. 2018. *Clay Mineral Catalysis of Organic Reactions*. Boca Raton, FL: CRC Press.

Book link:
The Chemistry of Clay-Organic Reactions | Benny K.G Theng | Taylor & F (taylorfrancis.com)



Photos: Benny Theng celebrating his publication of the newly revised edition of ‘The Chemistry of Clay-Organic Reactions’. Photo by J Drewry.

Thirty years in our Palmerston North building

We celebrated 30 years in our Palmerston North building on the Massey campus, with a morning tea on 12 August 2024. A number of previous staff attended including those who have retired or are with other organisations. It was interesting to see earlier photos of team members and how they’ve changed over the years.

Photo: Manaaki Whenua current and previous staff celebrating 30 years in our Palmerston North building. Photo: J Drewry

Massey University

Long term monitoring of oil and gas waste application to land in Taranaki

The Farmed Landscape Research Centre (FLRC) at Massey University is undertaking long term soil quality monitoring on land that has received oil and gas waste in coastal south Taranaki. Taranaki is home to an oil and gas industry that uses predominantly synthetic-based drilling mud for exploration and production. The mud is used to lubricate and cool the drill bit and control formation pressures during drilling. One means of disposing of spent mud is to apply it to land in a process called landfarming. This process has been used in south Taranaki to convert erosion-prone, sandy coastal sites into productive pasture. This involves stockpiling topsoil, recontouring the land to create a near flat surface, applying a thin layer of waste and working it into the underlying sand before re-applying topsoil (Figures 1 and 2). Dilution, atmospheric degradation and natural bioremediation then reduces the concentration of petroleum compounds.

Coastal south Taranaki comprises marine terraces overlain by a range of marine to terrestrial cover beds including dunes up to 20m high. Dune soils are well to excessively well drained, prone to drying out in summer, have potential for extreme

wind erosion and typically provide low value pasture production. Recontouring dunes to create flat paddocks with more even and better control of soil moisture and pasture growth has taken place in Taranaki for over a hundred years. More recently, landfarming has been introduced where mud application is thought to also increase the water and nutrient retention of sandy soils (McFarland et al. 2009) and therefore improve pasture production (Edmeades, 2013).

Most of the information to date concerning the influence of oil and gas waste on soil properties comes from compliance monitoring reports and a limited number of New Zealand studies (Taranaki Regional Council, 2011; Cavanagh et al. 2014; Cavanagh, 2015). There is very little information on the physical changes to the soil from landfarming and how that relates to soil quality and pasture production. Our study aims to address this knowledge gap by establishing long-term monitoring sites to assess the physical, chemical and biological properties of the soils through time.

FLRC staff have established and undertaken baseline sampling on a number of sites that received waste at different times between 2014-2023. A single control has been established on an untouched dune for comparison (Figure 1). Additional controls on reworked sand that has not received waste will be established at a future date. Baseline sampling involved digging and describing soil profiles, undertaking visual soil assessment, earthworm and infiltration measures and subdividing the profile into a number of horizons to take samples for wet chemistry, soil physics and microbial respiration (Figure 3 and 4).

Preliminary results demonstrate large variations in soil physics attributed to variations in waste type and application, mixing and earthworks across the waste application areas. In general, waste application sites show evidence of compaction and horizons that have received drilling waste usually display lower hydraulic conductivity. Baseline analysis is still being carried out and sites will be revisited on an annual basis.

Figure 1. Control site on dunes overlain by Castlecliff sandy loam, a well drained Typic Sandy Recent Soil.

Figure 2. Monitoring site on recontoured land that has received waste.

Figure 3. Layout of hydraulic conductivity, bulk density and retentivity cores taken from each horizon vertically down the soil profile.

Figure 4. A profile through anthropic soil comprising topsoil, a horizon that has received waste and underlying reworked black sand,

References:

Cavanagh, J.E., Booth, L., Stevenson, B., McGill, A., Campion, M. (2014). Biological response of earthworms and soil microbes associated with drilling mud wastes in the Taranaki Region. Landcare Research Contract Report LC1897 for Taranaki Regional Council. 33 p.

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McFarland, M.L., Feagley, S.E. and Provin, T.L., (2009). Land application of drilling fluids: landowner considerations. Texas Agrilife Extension Service Bulletin SCS-2009-08. 5 p.

Taranaki Regional Council (2011). Land farming of drilling wastes: Impacts on soil biota within sandy soils in Taranaki (year 1 of 3). Taranaki Regional Council Technical Report 2011-35. 41 p.

Canterbury and Otago

Lincoln University

Ode to Roger McLenaghen – a celebration of 50 years

To many generations of students and colleagues, Roger is, quite simply a legend. He brings a huge amount of mana to his role at Lincoln University. His involvement with not just teaching soil science but also the time he invests in outreach and extension activities (Young Farmers, Children’s University) is a reflection of his passion. A passion for not only the discipline of soil science, but also his enthusiasm for mentoring and teaching the next generation of agricultural scientists, especially our Diploma students. Roger is also passionate about how he teaches; he was an early adopter of using new technology in both course design and enhancement. His innovative teaching style in the laboratory and the field is memorable. Outside of work, Roger has had an impact in the local community through tennis and most significantly, the Lincoln Fire Brigade. Thank you Roger for your dedication of service to the department, university, and to the discipline of soil science. *Carol Smith*

Photos: Roger collecting soil samples Circa 1984; current photo on the job: celebrating at “The Lab”; morning tea celebrations in Waimarie

Manaaki Whenua – Landcare Research

Stephen McNeill retired after nearly 40 years with Manaaki Whenua and its predecessors. Stephen is well known for his expertise in mathematics, remote sensing, spatial analysis, statistics and geostatistics – many of which have been applied to soils. He has been involved in many projects including more recently in national soil carbon monitoring, carbon stocks, soil quality, remote sensing and developing pedotransfer functions for S-map. Stephen has over 2500 citations and has had a remarkable and varied career. We wish him all the best for the future.

AgResearch

Earlier this year **Marta Alfaro** and **Nicole Schon** from AgResearch travelled to the IUSS conference in Florence, Italy. The conference was celebrating its Centennial with 14 plenary sessions and 82 parallel sessions in themes such as soil health in achieving sustainable development goals, soils in the digital era and equity, diversity and inclusivity in soil sciences, new soil contaminants, greenhouse gas emissions and others. The conference was attended by more than 1400 participants from 73 countries.

Marta presented 'Different nitrogen fertiliser strategies to reduce nitrous oxide emissions on a potato rotation in a volcanic ash soil' and participated with the work 'Role of pH and nutrient source on the production and release of aucubin, acteoside and catapol in hydroponically grown Plantago lanceolata' and Nicole presented two talks on the 'Role of soil biology for health assessment' and 'Advancing soil health on grazed pastoral farms- a New Zealand perspective'. Marta also visited and explored collaboration with different nanotechnology laboratories including the Laboratorio Materiali Polimerici Ecocompatibili, LMPE (Italy) and the International Iberoamerican Nantechnology Laboratory, INL (Portugal).

While Nicole was overseas, she also took the opportunity to spend a few days with the Soil Biology Group at Wageningen University. Fortuitously, she got to experience the annual Earthworm Charming competition.

Earthworm charming competition at Wageningen University

News from the European Soil Data Centre

Soil degradation indicators in the EU
We make available the a Pan-EU assessment of soil degradation based on the 19 latest state-of-the-art indicators as demonstrated in the EUSO Soil Degradation Dashboard. Users can now develop maps based on the 19 soil degradation indicators (maps) as provided in the dashboard. The 'convergence of evidence' map in the dashboard shows where scientific evidence converges to indicate areas that are likely to be affected by soil degradation processes. The available dataset is a multi-band one with 20 bands (one per soil degradation indicator plus the combination of all indicators). Before use, it is recommended that users read carefully the documentation associated with the data and the related publication (How the EU Soil Observatory is providing solid science for healthy soils). Download the data:
https://esdac.jrc.ec.europa.eu/content/soil-degradation-indicators-eu

EUSO annual bulletin 2023
This report highlights the main activities of the EU Soil Observatory (EUSO) in 2023. The EUSO provided policy support to a wide range of policy areas, including the proposed Soil Monitoring Law. The EUSO also launched the EU Soil Health Dashboard, a comprehensive and easy understandable monitor of the state of soil health in the EU. Download the report:
https://publications.jrc.ec.europa.eu/repository/handle/JRC137235

Updates on the Soil Monitoring Law
Following the Soil Monitoring Law proposal from the European Commission, the Environment Council reached an agreement on Monday 17 June 2024. With the European Parliament having adopted its position earlier in April, the directive is now subject to trilogue negotiations. More information: Updates on the Soil Monitoring Law

Land degradation in Europe
Land degradation is a complex socio-environmental threat, which generally occurs as multiple concurrent pathways that remain largely unexplored in Europe. Here we present an unprecedented analysis of land multi-degradation in 40 continental countries, using 12 dataset-based processes that were modelled as land degradation convergence and combination pathways in Europe's agricultural (and arable) environments. The 12 indicators include: Water erosion, Wind erosion, Soil organic carbon loss, Soil salinization, Soil acidification, Soil compaction, Soil nutrient imbalances, Soil pollution via pesticides, Soil pollution via heavy metals, Vegetation degradation, Groundwater decline and Aridity. This dataset includes the Land Multi-degradation Index (LMI) for arable and agricultural lands and is documented in a Nature Communications publication https://doi.org/10.1038/s41467-024-48252-x

Abstracts

Predicting cadmium fractions in agricultural soils using proximal sensing techniques.

Cadmium (Cd) accumulation in agricultural systems has caused global environmental and health concerns. Application of phosphate fertiliser to sustain plant production unintentionally accumulated Cd in agricultural soils over time. Rapid and cost-effective Cd monitoring in these soils will help to inform Cd management practices. Compared to total Cd analysis, examining chemical fractions by sequential extraction methods can provide information on the origin, availability, and mobility of soil Cd, and to assess the potential plant Cd uptake. A total of 87 air-dried topsoil (0–15 cm) samples from pastoral farms with a history of long-term application of phosphate fertiliser were analysed using wet chemistry methods for total Cd and Cd forms in exchangeable, acid soluble, metal oxides bound, organic matter bound, and residual fractions. The data acquired using three proximal sensing techniques, visible-near-infrared (vis-NIR), mid-infrared (MIR), and portable X-ray fluorescence (pXRF) spectroscopy were used as input for partial least squares regression to develop models predicting total Cd and Cd fractions. The average total Cd concentration was 0.58 mg Cd/kg soil. For total Cd, cross-validation (cv) results of models using individual vis-NIR, MIR, and pXRF data performed with normalised root mean squared error ($nRMSE_{cv}$) of 26%, 30%, and 31% and concordance correlation coefficient (CCC_{cv}) of 0.85, 0.77, and 0.75, respectively. For exchangeable Cd, model using MIR data performed with $nRMSE_{cv}$ of 40% and CCC_{cv} of 0.57. For acid soluble and organic matter bound Cd, models using vis-NIR data performed with $nRMSE_{cv}$ of 11% and 33% and CCC_{cv} of 0.97 and 0.84, respectively. Reflectance spectroscopy techniques could potentially be applied as complementary tools to estimate total Cd and plant available and potentially available Cd fractions for effective implementation of Cd monitoring programmes.

Shrestha G, Calvelo-Pereira R, Poggio M, Jeyakumar P, Roudier P, Kereszturi G, Anderson CWN 2024. Predicting cadmium fractions in agricultural soils using proximal sensing techniques. Environmental Pollution 349: 123889. https://doi.org/10.1016/j.envpol.2024.123889

An improved pedotransfer function for soil hydrological properties in New Zealand

This paper describes a new pedotransfer function (PTF) for the soil water content of New Zealand soils at seven specific tensions (0, −5, −10, −20, −40, −100, −1500 kPa) using explanatory variables derived from the S-map soil mapping system. The model produces unbiased and physically plausible estimates of the response at each tension, as well as unbiased and physically plausible estimates of the response differences that define derived properties (e.g., macroporosity and total available water content). The PTF is a development of an earlier model using approximately double the number of sites compared with the earlier study, a change in fitting methodology to a semiparametric GAM Beta response, and the inclusion of sample depth. The results show that the new model has resulted in significant improvements for the soil water content estimates and derived

quantities using standard goodness-of-fit measures, based on validation data. A comparison with an international PTF using explanatory variables compatible with variables available from S-map (EUPTF2) suggests that the model is better for prediction of soil water content using the limited information available from the S-map system.

McNeill S, Lilburne L, Vickers S, Webb T, Carrick S 2024. An improved pedotransfer function for soil hydrological properties in New Zealand. Applied Sciences 14(10): 3997. https://doi.org/10.3390/app14103997

Difficulties in using land use pressure and soil quality indicators to predict water quality.

Intensive agriculture can impair river water quality. Soil quality monitoring has been used to measure the effect of land use intensification on water quality at a point and field scales but not at the catchment scale. Other farm scale land use pressures, like stocking rate and the value of land, which relate to land use intensity are now publicly available, nationally. We therefore tested whether point scale soil quality measures, together with newly available farm scale land use pressures (land valuation and stocking rate) and existing catchment and climatic characteristics could help predict the behaviour of water quality data across 192 catchments in New Zealand. We used a generalised additive model to make predictions of the change in nitrogen fractions (r^2 = 0.65-0.71), phosphorus fractions (r^2 = 0.51-0.70), clarity and turbidity (r^2 = 0.42-0.46), and *E. coli* (r^2 = 0.35) over 15 years. The state and trend of water quality was strongly related to a refined farm scale land use classification, and to catchment and climatic characteristics (e.g. slope, elevation, and rainfall). Relationships with point scale soil quality measures and the land use pressures were weak. The weak relationship with land use pressures may be caused by using a single snapshot in time (2022), which cannot account for lag times in water quality response but leaves room for additional temporal data to improve predictive power. The weak relationship to soil quality measures was probably caused by limited data points (n = 667 sites) that were unrepresentative of land use, and areas of catchment subject to processes like runoff or leaching. While national soil quality measures might be useful for evaluating environmental risk at the field or farm scale, without a large increase in sampling, they were not relevant at the catchment scale. Additional analyses should be performed to determine how many samples would be needed to detect a change using an environmentally focused soil test that can guide water quality management.

McDowell RW, McNeill SJ, Drewry JJ, Law R, Stevenson BA 2024. Difficulties in using land use pressure and soil quality indicators to predict water quality. Science of the Total Environment 935: 173445. https://doi.org/10.1016/j.scitotenv.2024.173445

Land use intensity is a major driver of soil microbial and carbon cycling across an agricultural landscape

Soil carbon (C) storage is a critical ecosystem function that underpins human health and well-being. The acceleration of human-driven land use change, such as agricultural intensification, is a major driver of soil C loss globally. Developing sustainable land use practices that enhance agricultural productivity whilst protecting essential ecosystem functions such as soil C storage is vital. The soil microbiome has a critical role in regulating soil biogeochemical cycling processes, including soil C cycling. Examining the impacts of land use intensity on the soil microbiome enables us to assess the potential effects on long-term soil C stocks. Using metagenomic DNA sequencing and phospholipid fatty acid analysis, we investigated differences in the activity, diversity, and function of the soil microbiome associated with five contrasting land uses across an agricultural landscape. The land uses covered a gradient of disturbance intensities and included remnant native forest, regenerating native bush, exotic plantation forest, dryland pasture, and irrigated pasture. We identified pronounced differences in the soil microbiome associated with each land use, including the diversity and abundance of microbial C and nitrogen (N) cycling genes. Notably, intensive agricultural land uses had a significantly higher diversity and abundance of microbial C-degrading genes, whilst land uses of remnant native forest had the lowest diversity and abundance of microbial C-degrading genes. Our findings suggest that intensive agricultural land use may increase the functional potential of the soil microbiome to mineralize soil C, potentially resulting in a greater loss of soil C as respired CO_2 into the atmosphere. This research may be used to support the development of sustainable management practices that promote the persistence of soil C across agricultural landscapes, such as the protection of remnant native forest fragments and greater incorporation of regenerating native vegetation.

Byers AK, Condron L, Wakelin SA, Black A (2024) Land use intensity is a major driver of soil microbial and carbon cycling across an agricultural landscape. Soil Biology and Biochemistry 196 109508.
https://doi.org/10.1016/j.soilbio.2024.109508

Developing Vis-NIR libraries to predict cation exchange capacity (CEC) and pH in Australian sugarcane soil

In sugarcane growing areas of Queensland Australia, management of soil condition requires information about soil chemical properties (i.e., cation exchange capacity [CEC], and pH), because they are used to make fertiliser recommendations. While laboratory analysis is cost prohibitive the development of visible near-infrared (Vis-NIR) spectroscopy libraries might be useful. The aims of this study was to compare: i) linear (i.e., Partial least squares regression [PLSR]) and machine learning (i.e., Cubist, Random Forest [RF] and Support vector machine [SVM]) algorithms in terms of their calibration strength (i.e., coefficient of determination (R^2); ii) depth-specific (i.e., topsoil [0 – 0.3 m], subsurface [0.3 – 0.6 m], subsoil [0.6 – 0.9 m] and deep subsoil [0.9 – 1.2 m]) and multi-depth libraries; iii) prediction R^2, agreement (Lin's concordance correlation coefficient [LCCC]) and accuracy (ratio of performance to interquartile [RPIQ]); and iv) minimum number of calibration sample locations (i.e., n = 400, 350, …, 50). For depth-specific calibration for CEC, strong calibration R^2 was achieved for the subsurface (i.e., RF [0.95], Cubist [0.93], PLSR [0.88] and SVM [0.81]), and for pH, the largest R^2 was for deep subsoil (i.e., RF [0.91], followed by PLSR [0.80], Cubist

[0.79] and SVM [0.56]), with subsurface, and deep subsoil similar, with topsoil R^2 smaller. In terms of model prediction of depth-specific, Cubist was superior to PLSR, RF and SVM for CEC, and PLSR was the best for pH. For example, agreement for topsoil CEC was substantial for Cubist (0.80) and PLSR (0.80), but moderate for RF (0.69) and poor for SVM (0.59). For subsurface (0.9), subsoil (0.91) and deep subsoil (0.92), the agreements were perfect for CEC using Cubist. In terms of multi-depth calibration for CEC it was strong for RF (R^2 = 0.94), Cubist (0.92), PLSR (0.81) and SVM (0.72), but for prediction agreement, Cubist (LCCC = 0.92) was perfect, with PLSR (0.85), RF (0.84) and SVM (0.83) substantial. This was also the case for pH (0.84) substantial. However, there are efficiencies in developing a multi-depth calibration. Moreover, the minimum number of calibration sample sites required was 300 (i.e., 1,200 samples) (1.78 sites/ha). The results have implications for using a Vis-NIR library to replace traditional soil laboratory analysis and for fertiliser recommendations for sugarcane soil.

Zhao X, Wang J, Koganti T, Triantafilis J 2024. Developing Vis-NIR libraries to predict cation exchange capacity (CEC) and pH in Australian sugarcane soil. Computers and Electronics in Agriculture 221: 109004. https://doi.org/10.1016/j.compag.2024.109004

Application of mid-infrared (MIR) spectroscopy to identify and quantify minerals in New Zealand soils

The analysis and characterization of soil minerals rely on the availability and capability of experts, therefore greatly influencing the efficiency and accuracy of mineral analysis. Mid-infrared (MIR) spectroscopy offers a low-cost, high-throughput alternative, as it instantly records the spectral signatures of soil minerals through the absorption of infrared radiation. This study investigates the potential of MIR spectroscopy to identify and quantify the most common minerals in the clay (<2 μm) fraction of New Zealand soils. We analysed 3,097 samples and developed partial least squares regression (PLSR) models to quantify the concentration for each of the 11 mineral types in the collated database. In addition, we developed a partial least squares discriminant analysis (PLS-DA) model to identify the dominant mineral of the analysed soil samples. Most models used for quantifying mineral compositions indicate high accuracy. The highest values of R^2 (0.81), Lin's concordance correlation coefficient (0.90), RPIQ (4), and the lowest bias (−0.26 %) were obtained for the quantification of mica on the test set. For the identification of the dominant mineral, the overall accuracy was 75 % on the test set. In addition, we could correctly classify 94 % of the samples dominated by mica, 86 % of the samples by volcanic glass/amorphous silica, 82 % of the samples by allophane/imogolite, and 77 % of samples dominated by kaolin-smectite. Thus, MIR spectroscopy offers a valuable solution for mineral quantification and identification, especially in areas where quantified mineral databases are not readily available and human expertise is lacking.

Ma YX, Minasny B, Roudier P, Theng BKG, Carrick S 2024. Application of mid-infrared (MIR) spectroscopy to identify and quantify minerals in New Zealand soils. Catena 242: 13. WOS:001247578000001 https://doi.org/10.1016/j.catena.2024.108115

Derivation of physically based soil hydraulic parameters in New Zealand by combining soil physics and hydropedology

Field-characterised soil morphological data (to 1 m depth) and modelled soil water release characteristics are recorded in the S-map database for soils covering approximately 40% of New Zealand's soil area. This paper shows the development of the Smap-Hydro database that estimates hydraulic parameters by synergising soil morphologic data recorded in S-map and soil physics. The Smap-Hydro parameters were derived using the bi-modal Kosugi hydraulic function. The validity of the Smap-Hydro parameters was tested by applying them within an uncalibrated physically based hydrological model (HyPix) and comparing results with soil water content, θ, measured with Aquaflex soil moisture probes (0–40 cm deep) at 24 sites across New Zealand. The HyPix model provided an excellent fit with observed soil water content for 25% of the sites, a good fit for 33% of the sites and a poor fit for 42% of the sites. Applying the model to all soils in the S-map database required adjustments for the occurrence of rock fragments, hydraulic discontinuities caused by soil pans and required the addition of boundary conditions for water tables and the occurrence of impermeable rock. A discussion on how we can further synergise the development of pedotransfer functions with knowledge of soil physics is provided.

Pollacco JAP, Fernández-Gálvez J, Webb T, Vickers S, Robertson B, McNeill S, Lilburne L, Rajanayaka C, Chau HW 2024. Derivation of physically based soil hydraulic parameters in New Zealand by combining soil physics and hydropedology. European Journal of Soil Science 75(3): 21. WOS:001234238300001 https://doi.org/10.1111/ejss.13502

Exploring the post-harvest ‘window of vulnerability’ to landslides in New Zealand steepland plantation forests

Nature-based solutions (NbS) are actions to address societal problems. They are similar to soil and water bioengineering (SWB), where trees and forests are used to mitigate natural hazards. However, NbS can have unintended consequences. Forest-based NbS may involve the enhancement, rehabilitation or restoration of natural forests or planting of trees and forests to provide a range of services including the production of timber and wood. In New Zealand, planted steepland forests have been widely used as NbS for erosion control. While intact, these forests provide various beneficial ecosystem services. However, if these forests are harvested, there is a period of up to 6–8 years following clear-fell harvesting, known as the ‘window of vulnerability' (WoV) when the landscape is susceptible to rainfall-induced landslides. During this time, the combination of declining root strength and changes in soil hydrology can lead to shallow landslides, especially during heavy storms. This study focuses on three questions: determining whether there is a time within the WoV when susceptibility to rainfall-induced landslides, expressed as landslide density, reaches a maximum; are such landslides related to forestry infrastructure; and are those landslides connected to the stream network. We examined three areas in New Zealand (Tolaga Bay, Marlborough, and Tasman) where exceptional rain events triggered thousands of landslides on forest land harvested in the years immediately preceding those events. Using a range of

highresolution satellite imagery, we manually mapped rainfall-induced landslides and identified those due to the rain events. The maximum landslide number and density occurred on land harvested 1-4 years (and on average 2-3 years) before the event and varied slightly for each study area. Landslides also occurred in areas with trees up to harvest age of about 30 years and on areas with different vegetation covers, i.e., mature indigenous forests, pasture, scrub, etc. There were fewer landslides associated with forest infrastructure such as roads and landings than triggered on clearcut slopes. On average across the three study regions, about half the landslides were connected to streamlines, and so were able to deliver sediment and woody debris. Better information on susceptibility to rainfall-induced landslides following forest removal may help forest managers and regulators understand this hazard and what can (and cannot) be done to mitigate events which often result in 'disastrous' off-forest impacts as observed in New Zealand in recent years.

Phillips C, Betts H, Smith HG, Tsyplenkov A (2024) Exploring the post-harvest 'window of vulnerability' to landslides in New Zealand steepland plantation forests. Ecological Engineering 206 107300. https://doi.org/10.1016/j.ecoleng.2024.107300

An examination of the ability of plantain (*Plantago lanceolata L.*) to mitigate nitrogen leaching from pasture systems

Plantain (*Plantago lanceolata* L.) has recently been thrust into the limelight as a potential tool for mitigating nitrogen losses from the New Zealand pastoral environment. It is claimed to possess characteristics to reduce nitrogen leaching through both animal and soil-based mechanisms. This review examines the use of plantain in New Zealand pastures and the research that has led to these claims. The focus is on the evaluation of scientific evidence for the mechanisms through which plantain is proposed to reduce nitrate leaching, as well as the research on the implementation of plantain into pastoral farm systems. Plantain clearly increases the urination of grazing animals; a trait not unique to plantain. This review concludes that many research studies supporting the beneficial impact of plantain do not stand up against scientific scrutiny associated with methodology and interpretation of data. It is recommended more research should be undertaken on other pasture species and management tools, that may be more effective alternatives to plantain for nitrogen mitigation in pastures.

Eady C, Conner AJ, Rowarth JS, Coles GD, Deighton MH, Moot DJ 2024. An examination of the ability of plantain (*Plantago lanceolata L.*) to mitigate nitrogen leaching from pasture systems. New Zealand Journal of Agricultural Research: 1-28. https://doi.org/10.1080/00288233.2024.2373220

Changes to soil profile carbon and nutrient distribution following pasture renewal with full inversion tillage

Full inversion tillage (FIT) at pasture renewal is a management option aiming to increase carbon stocks in long-term pasture, to achieve carbon neutrality. This study investigated the effects of FIT on carbon and nutrient distribution in the soil profile (0-7.5, 7.5-15, 15-22.5 and 22.5-30 cm depths) as well as nutrient uptake,

and subsequent fodder crop and/or pasture yields across three pasture renewal trials (Trials 1 and 3: Alfisol; Trial 2: Andisol). These effects of FIT were assessed against standard tillage treatments (no till, shallow till), and non-renewed pasture within 8–18 months post-tillage. FIT changed soil carbon stratification, causing 16%–46% reduction in topsoil (0–7.5 cm) cation exchange capacity across the three trials. However, nutrient levels after FIT remained within recommended ranges for crop and/or pasture growth, avoiding any yield reductions. Topsoil fertility post-FIT depended on original degree of nutrient stratification in the soil profile. At Trial 1, temporary deficiencies caused by low subsoil P and K soil tests pre-FIT were anticipated and corrected with fertiliser nutrients for the following break crop and resown pasture. We conclude that soil testing the cultivation depth prior to FIT at pasture renewal provides the necessary soil test information to manage yield expectations.

Amanor YJ, Hanly JA, Calvelo-Pereira R, Hedley MJ 2024 Changes to soil profile carbon and nutrient distribution following pasture renewal with full inversion tillage. New Zealand Journal of Agricultural Research: 1-21. https://doi.org/10.1080/00288233.2024.2371113

Routine stream monitoring data enables the unravelling of hydrological pathways and transfers of agricultural contaminants through catchments

Catchment-scale understanding of water and contaminant fluxes through all pathways is essential to address land use and climate change impacts on freshwater. However, few options exist to obtain this understanding for the many catchments worldwide for which streamflow and low-frequency water chemistry, but little other data, exists. We applied the Bayesian chemistry-assisted hydrograph separation and load partitioning model (BACH) to 47 catchments with widely differing characteristics. As BACH relies on concentration differences between pathways, chemodynamic behaviour of a water constituent indicates its likely suitability as tracer. Typical tracers (e.g. silica, chloride) were unavailable, but Electrical Conductivity and a few monitored nutrients proved chemodynamic in most catchments. Using one of two tracer combinations (Total Nitrogen + Electrical Conductivity, Total Nitrogen + Total Phosphorus) allowed in 85% of the catchments to estimate streamflow contributions by near-surface (NS), shallow groundwater (SGW), and deep groundwater (DGW) pathways and pathway-specific tracer concentrations and yields with acceptable confidence. In 46 catchments, at least two pathways contributed ≥20 % of the streamflow, and all three ≥20 % in 12 catchments, cautioning against the notion of a single ‘dominant’ pathway. In contrast to hydrometric hydrograph separation, BACH allows differentiation between ‘young’ (NS + SGW) and ‘old’ (DGW) water, which is crucial for the understanding of pollution in catchments with strong temporal gradients in land use intensity.

Stenger R, Park J, Clague J. 2024 Routine stream monitoring data enables the unravelling of hydrological pathways and transfers of agricultural contaminants through catchments. Science of the Total Environment 912 169370. https://doi.org/10.1016/j.scitotenv.2023.169370

Deadline..... for the next issue of Soil News is 11 November

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