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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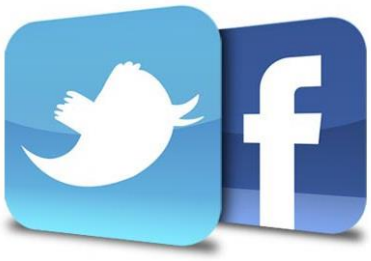

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From the editor

Welcome to this issue of Soil News. Many thanks to Roberta Gentile who has been the Plant and Food Research North Island Soils News correspondent for 10 years. Our correspondents provide a lot of material and interest for Soil News readers, so Roberta's efforts are much appreciated by all. We are also pleased to introduce Matt Norris as Roberta's replacement as the Plant and Food Research North Island Soils News correspondent. Matt is an environmental scientist at Ruakura.

This issue includes a memorial article for Allan Hewitt, which outlines the background to the development of soil classification in New Zealand.

I saw the 'Sunday' programme on TV1 on 21 August 2022 about a subdivision south of Lincoln town boundary and the high-class soils in the area – see article below.

Many thanks to Isabelle Vanderkolk and her help and contribution to compiling Soil News over many years since 2007. Isabelle is retiring in August and has written a message below for readers.

Newsletter compiler signs off

I took on the "voluntary" job of compiling the NZSSS newsletters back in February 2007 when Alec Mackay (my colleague at AgResearch) became President. Little did I know I would still be doing it 15 years later.

In the beginning everything was manual - the newsletter was put together in a PDF form, printed over at Massey and then posted out in hard copy to every member, two monthly. With the advent of the electronic version (now produced 4 times a year), the workload certainly decreased.

Around the time you read this edition I will be retiring from AgResearch and looking forward to new adventures, a lower golf handicap, a tidier garden and time to spend with my grandchildren. I've really enjoyed being involved with NZSSS, and wish you all the best.

Isabelle Vanderkolk

Lincoln subdivision on high-class soils

I saw the 'Sunday' programme on TV1 on 21 August 2022. It was about the district council approving a 1710-home subdivision south of Lincoln town boundary. The article was about local farmers and residents opposing the subdivision, with the Environment Court, with a focus in their argument being the development's location on high class soils.

A couple of soil profile representations were shown, one stony, one not. Hence an argument that if a subdivision was to go ahead, buildings should be on stony, less productive and less versatile soils. Information from a newspaper article (see below) states "Among their chief concerns was loss of highly productive soils, particularly on the verge of Government planning to make its final decisions on the proposed National Policy Statement for Highly Productive Land next month."

This Sunday programme builds on an earlier programme in May 2021, on the impact of urban sprawl at Pukekohe. In the Hawke's Bay, a farmer-lead group has also formed the 'Save Our Plains' group, focussed on the loss of Highly Productive Land on the Heretaunga Plains.

Further information:
Lincoln highly productive land issue
'Sunday' programme August 2022 "The price of progress"
https://www.youtube.com/watch?v=LmcFI69j02I

Newspaper article https://www.stuff.co.nz/national/politics/local-government/128891698/canterbury-town-set-to-double-in-size-after-approval-of-controversial-subdivision

Pukekohe highly productive land issue
'Sunday' programme May 2021 https://www.1news.co.nz/2021/05/16/taking-stock-of-our-soil-how-housing-developments-are-threatening-nzs-fertile-land/
'Testing the boundaries to circumvent policy that aim to protect our best land and soils', by Fiona Curran-Cournane (Soil News in May 2021)

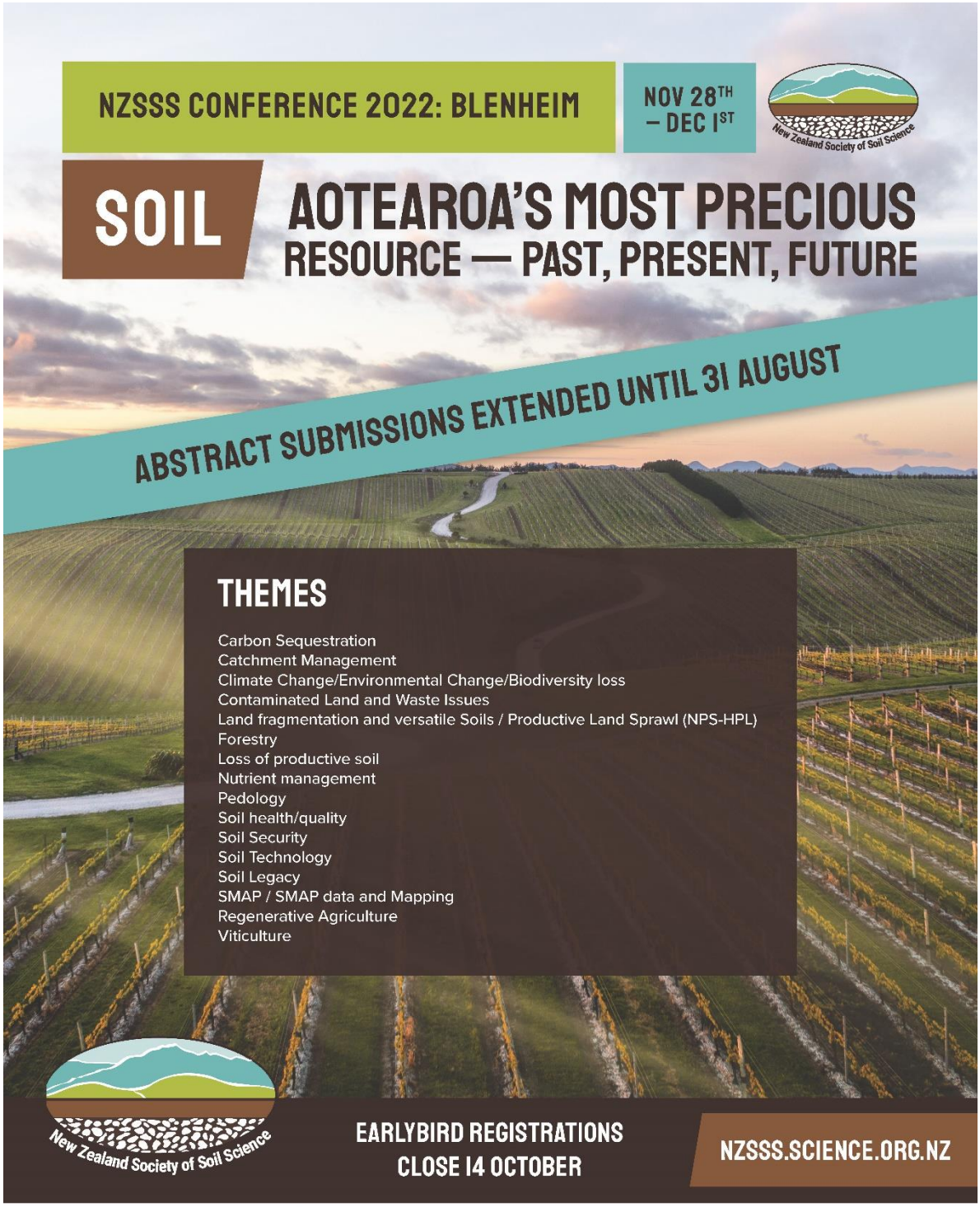
In addition, there are several research papers about the impact of urbanisation on land fragmentation and high-class soils in New Zealand, including:

Curran-Cournane F, Carrick S, Barnes MG, Ausseil A-G, Drewry JJ, Bain IA, Golubiewski N, Jones H, Barringer J, Morell L 2021. Cumulative effects of fragmentation and development on highly productive land in New Zealand. New Zealand Journal of Agricultural Research. (On-line early, open access). https://doi.org/10.1080/00288233.2021.1918185

Curran-Cournane F, Golubiewski N, Buckthought L 2018. The odds appear stacked against versatile land: can we change them? New Zealand Journal of Agricultural Research 61(3): 315-326. (Open access). https://doi.org/10.1080/00288233.2018.1430590

John Drewry

NZSSS conference



ARL analytical research laboratories
Ballance agri-nutrients
Manaaki Whenua Landcare Research
Potatoes NEW ZEALAND
Royal Society Te Aparangi
Hill Laboratories TRIED, TESTED AND TRUSTED
FAR
LANDSYSTEMS KNOW YOUR LAND
Plant & Food Research Rangahau Ahumāra Kai

Early career researcher profile - Kirstin Deuss

At the last Council meeting we had the pleasure to elect the inaugural Early Career Researchers representative, Kirstin Deuss (Manaaki Whenua, Lincoln). Kirstin grew up on a small farm in Pauatahanui and spent 10 years working in a horticultural business supplying culinary herbs to the local restaurant trade. Following her undergraduate degree in Biomedical Science at Victoria University of Wellington, she changed paths and moved to Germany to undertake a MSc in Horticultural Sciences at the Technical University of Munich

It was during her Masters that Kirstin discovered and developed a passion for soil science. After moving back to New Zealand, she began a job with Environment Southland coordinating a regional soil sampling project and carrying out field work for surface water hydrology projects.

In 2017, Kirstin began a PhD in Soil Physics at Lincoln University under the supervision of Peter Almond and Sam Carrick. Her research involved a multi-disciplinary study of the soil and catchment hydrology of a mole-and-tile drained, loess-mantled landscape in Southland. She investigated the influence of loess stratigraphy on the partitioning of soil attribute variability, characterised the artificial drainage network using proximal soil sensing techniques, and quantified the spatiotemporal variability and controls of runoff and deep drainage at the event and catchment-scale. Kirstin's work was awarded the 2021 Fertiliser Association Award, which recognises the efforts and present, or likely, contribution to New Zealand soil science arising from a Doctorate study.

After submitting her PhD Thesis in February this year, Kirstin started a new role as a soil scientist and pedologist at Manaaki Whenua - Landcare Research in Lincoln. She is currently leading the S-Map expansion project in the Marlborough region and is regularly in the field for soil survey. She has a curious mind, and her multi-disciplinary background has led to a wide range of experience and research interests (including digital soil mapping, geomorphology, and pedology).

Kirstin is actively involved in promoting soil science within the early-career researcher community and looks forward to contributing her passion and energy to the NZSSS. At present she is part of the organising committee for the 2022 NZSSS Soil Judging Competition, as well as being co-organiser of the 2022 NZSSS conference Early-

Career Events. She has a soft spot for soil judging competitions, which engages people from all walks of life in the fascinating world of soil. She is also active in promoting soils to the general public and enjoys bringing together people with an interest or background in soils and soil science.

Outside of work, Kirstin enjoys mountain biking and tramping, and any other activities that get her into the outdoors.

Seeking feedback on sharing more soil profile data (survey)

Please take part in a short survey

Manaaki Whenua maintains and operates the National Soils Database Repository (NSDR), which contains soil observations and soil analytical results for New Zealand soil profiles. We have data for several thousand soil profiles we'd like to share, while considering concerns about data privacy. In a 5-10 minute survey we would like your feedback on the value of having access to soil profile data that has limited locational data.

Follow this link https://www.surveymonkey.com/r/QXPMYF3 to participate and you can choose to enter a draw to win a $100 eGift card to MacPac. Please forward the link to others who would be interested.

For more information contact Shana Dooley at dooleys@landcareresearch.co.nz

Dr Allan Edward Hewitt (1949–2022). A memorial to his legacy of soil classification in New Zealand

Philip Tonkin, Christchurch

Dr Allan Hewitt died after a slow decline in his health and at his funeral his wife Liz gave us a picture of Allan as husband, father and soil scientist. In his last days Allan together with Dr Megan Balks and Professor David Lowe brought to publication a fine volume that presents and illustrates the achievements of the "New Zealand Soil Classification" that Allan worked on since the early 1980s. Apart from the back story to the publishing of "The soils of Aotearoa New Zealand" (Hewitt, Balks and Lowe 2021), a story known best to Liz Hewitt, Megan and David, there is another story about the people and various influences on the progressive development of soil classification in New Zealand.

There are three short phrases that come to mind when talking of pedology: soil genesis, soil mapping and soil classification. The roots of pedology are in the field, observing the soils and their relationships in the landscape. So perhaps soil mapping is the initial activity, but soil mapping requires an accepted code for recognizing and recording features of the soil profile, and its origins, that leads to the evolving classification of soils. Soil classification requires more than visual recognition of the soil profile. It additionally requires a knowledge of processes within the soil continuum and an understanding of soil genesis. Therefore, soil mapping, soil classification and soil genesis together comprise a cyclic process with several iterations over the history of pedology throughout the 19th century up until the present. As an American pedologist, Roy Simonson, noted, "Classification of soils at any point in history largely reflects current understanding of soil genesis" (Simonson, 1962).

In this tribute to Dr Allan Hewitt I want to focus on those who have contributed to the cyclic process of soil knowledge and understanding. An outline history of soil survey in New Zealand is recorded in Tonkin (2007) but this history does not record the other influences on the development of soil classification. A review of the relevant background culminating in the United States Department of Agriculture's "Soil Taxonomy" is to be found in "Soil Genesis and Classification" by Buol, Hole and McCracken (1973). The influence on New Zealand soil science began with the period of leadership by Dr C.F. Marbut in the United States. Marbut was born and raised on a Missouri farm, began as school teacher in Nebraska, studied geology at the University of Missouri and after graduating was appointed to the Missouri State Geological Survey as a field geologist. In 1893 he enrolled at Harvard University where he studied under the renowned geomorphologist, Professor William Morris Davis, graduating with a masterate degree in geology and beginning study for a Ph.D. which he did not complete. Marbut returned to the University of Missouri, eventually becoming Professor of Geology and Director of the State Soil Survey. By 1912 he was appointed Chief of the Division of Soil Survey in the United States Department of Agriculture. His interests evolved from the traditional examination of soil physical and chemical components to the morphology of soils and their distribution in the field. He developed an interest in the Russian ideas of V.V. Dokuchaev and his student K.D. Glinka. In 1927, Marbut published his translation into English of the German edition of Glinka's "The Great Soil Groups of the World and Their Development". In that same year Theodore Rigg (later Sir Theodore) of the Cawthron Institute in Nelson attended

the first International Soil Congress in Washington USA (Rigg, 1928) and he reported on the soil classification based on climate, geology, texture and chemical composition. In this soil classification, K.D. Glinka recognized Laterite, Podzol, Steppe, Solonetz and Marsh and Wet land soils.

By 1926 the New Zealand Government reorganized science, forming the Council and Department of Scientific and Industrial Research (DSIR) with Dr Ernest Marsden appointed as Secretary. The Geological Survey and Dominion Laboratory were incorporated into the new department. Rigg was a council member and facilitated collaboration between the Cawthron Institute and the early soil surveys undertaken by Hartley Ferrar and Norman Taylor in the Te Kuiti Survey and Les Grange in the Rotorua Survey. Access to Marbut's translation of Glinka's book transformed the approach taken in these early soil surveys into the relationship between soils and stock health known at the time as bush sickness, subsequently recognized as a lack of cobalt leading to vitamin B12 deficiency. This transformation is well illustrated in two early papers by Taylor in a study of soil processes in volcanic ash beds (Taylor 1933 a, b). In this period Taylor was an assistant geologist with Ferrar studying the geology and soils of the Mairoa and King Country areas encompassed within the Te Kuiti Survey, and Grange was studying the geology, volcanic history and volcanic ash beds of the central North Island. His was a foundation for subsequent studies of volcanic ash beds (tephra) in New Zealand. In these early years Grange and Taylor were involved in soil surveys in the Waikato, Taranaki, Northland, South Canterbury and Western Samoa. In 1933 a soil survey section was established in the DSIR Geological Survey and by 1936 it became a separate branch of DSIR with Les Grange as Director. Grange was awarded a D.Sc. in 1936 by the University of Otago for his thesis on a "Study of genetic soil types in New Zealand", the first step in a comprehensive classification of New Zealand soils. A glimpse into Dr Grange's approach to soil classification is to be seen in two articles published in the *New Zealand Journal of Agriculture*: Grange (1945) North Island soils; Grange (1946) South Island soils. In these articles he recognized; Recent soils, Yellow Grey Loams, Podzols, Brown Loams, Yellow Brown Loams, Brown Granular Clays, Red-Brown Loams, Meadow soils, Peaty soils and Skeletal soils in the North Island. In the South Island he recognized Recent soils formed from alluvium, Low land Tussock soils, High land Tussock soils; young, semimature and mature Podzolic soils, Brown Loams, Meadow soils, Peaty soils, and Skeletal soils. With the onset of the Second World War emergency soil survey was redirected to completing a reconnaissance of the soils of the North Island of New Zealand to be followed by a comparable survey of the South Island. The preliminary maps for the North Island that included areas previously surveyed were completed in the early 1940s with their eventual publication after the war (Soil Bureau Staff, 1954). An indication of the status of soil classification in New Zealand can be gained from the map legends in this reconnaissance survey of North Island soils.

In the 1938 "Soils and Men" Year Book of Agriculture, an article on soil classification (Baldwin, Kellogg and Thorp, 1938) revised the existing United States Department of Agriculture classification, grouping soils into three orders: Zonal, Intrazonal and Azonal, with a discussion of the general features of the soils included within each of these orders. Within each order there were a number of great groups that could be further subdivided into soil series, types and phases. In 1948, Norman Taylor published a soil map of New Zealand (Taylor, 1948) and this map had a comprehensive legend that showed soils in three orders: Zonal, Intrazonal and Azonal. This soil map was to be accompanied by *New Zealand Soil Bureau Bulletin* 3, but this

was never published. Taylor gave a presentation on his revised classification at the 7th Pacific Science Congress in 1949 (Taylor, 1949) and a brief paper was published illustrating the general model (Taylor and Cox, 1956). Over the following decades the Taylor soil classification was used by Soil Bureau scientists and others in the Department of Agriculture to organized and explore relationships between soils, their fertility and management. Norman Wells in his N.H. Taylor Memorial Lecture stated that Taylor's 1948 genetic soil map was a major leap forward in the logical arrangement of soils in New Zealand (Wells, 1984). Another key contribution to understanding of soils and their environment was heralded by Hans Jenny's book "Factors of Soil Formation" (Jenny, 1941). Professor T.W. Walker and colleagues at Canterbury Agricultural College (now Lincoln University) followed the soil-forming factor approach in their studies of soil sequences with the assistance of pedologists Eddie Cutler, Colin Vucetich and James Raeside. In 1962 Taylor's last year as Director of Soil Bureau an International meeting of Commissions 4 (Soil fertility) and 5 (Pedology) was held at Massey College (now University) in Palmerston North. As a lead in to this conference, Norman Taylor and Ivan Pohlen published "Soil Survey Method" and in this book there was a revised version of the Taylor's soil classification with new technical terminology (Taylor and Pohlen, 1962). This classification, referred to as the "New Zealand Genetic Soil Classification", was set out with more detail and discussion in "Soils of New Zealand Part 1" (Taylor and Pohlen, 1968).

The 1960s through to the late 1980s was a time of development of a revised United States soil classification, "Soil Taxonomy", through a sequence of approximations up until the present. Two American pedologist were key to the inception and development of this classification: Dr G.D. Smith and Professor M.G. Cline. Dr Guy Smith was born in Atlantic Iowa in 1907, graduated in science at the University of Illinois, gained a Master of Arts at the University of Missouri in 1934 and a Ph.D. from the University of Illinois in 1940. He held positions in soil physics and soil survey in the University of Illinois from 1935 to 1942, was in the U.S. Army Airforce from 1942 to 1946. After his war service he held various positions in the United States Department of Agriculture ultimately becoming Director of Soil Survey Investigations for the nation until his retirement in 1972. After retirement he served as visiting professor at the University of Ghent, Belgium. The first edition of "Soil Taxonomy", published in 1975 as Agricultural Handbook No. 436, was the culmination of 23 years of his leadership to develop a new system of soil classification. Professor Marlin G. Cline spent 35 years at Cornell University at Ithaca, New York State, a private land grant university, as a widely respected pedologist. He was born in 1909 on a dairy farm in Minnesota, obtained a B.S. degree from North Dakota Agricultural College in 1935, and spent several years in the United States Department of Agriculture on soil surveys in North Dakota, Hawaii and Tennessee. He graduated Ph.D. at Cornell University in 1942, was hired for teaching and research in soil classification and geography and during the Second World war he was granted leave for strategic intelligence involving soil conditions in Asia. Following the war he became involved in methods of soil classification and was recognized as an authority (Cline, 1949, 1977). He travelled extensively studying soils and various aspects of land use in East Africa, Philippines, Brazil and sub-Saharan Africa. These experiences influenced him and he became a promoter of a tropical soils programme at Cornell University when Department Chair from 1963 – 1970. He died in 2009 at age 99. It was upon Professor Cline's knowledge and reputation that Cornell University became a base for further studies of soil classification.

From 1968 to 1969 Dr Bruce Miller of the Soil Bureau was an Andre Meyer Fellow at the United Nations Food and Agriculture Organization in Rome to work on the "Soil Map of the World" with Dr Rudi Dudal's team. Dr Rudi Dudal graduated Ph.D. in agricultural science from Katholieke Universiteit Leuven, Belgium, in 1955. He began his career with the Belgian soil survey and joined the UNFAO as a technical assistant on soil resources in Indonesia. In 1960 he was posted to UNFAO headquarters in Rome to become correlator for UNFAO/UNESCO "Soil Map of the World". From 1986 to 1992 he played a key role in establishing the map legend which then formed the basis for the World Reference Base (WRB) for soil classification. In 2010 he was awarded the first Guy Smith Award by the Commission on Soil Classification of the International Union for Soil Sciences. He died in 2014. When Dr Bruce Miller returned to New Zealand he suggested that "Soil Taxonomy" developed by Dr Smith and others in the United States should be considered as a replacement of the Taylor and Pohlen "New Zealand Genetic Soil Classification". Then began a decade of examining the use of "Soil Taxonomy" with a number of international meetings in which Dr Michael Leamy and other Soil Bureau staff were involved. In 1977– 1978 Dr Guy Smith spent time in New Zealand working with Dr Leamy and they produced a series of "Conversations in Taxonomy", the last of which were recorded at the University of Ghent in 1980 (Smith and Leamy, 1982). All the interviews, and further discussions, were compiled into a single volume by Forbes (1986). After this period of trial of "Soil Taxonomy", it was decided that further examination of a revised New Zealand soil classification should be considered. However, a significant outcome of this period of Dr Leamy working with Dr Smith and other collaborators was an international committee working on a revision of Andepts to develop the classification of an Andisol order in "Soil Taxonomy" (Smith, 1978). This International Committee on the Classification of Andisols (ICOMAND) had Dr Leamy as its first chairman. Dr Michael Leamy joined the Soil Bureau as a cadet in 1949 and attended Victoria University College (now University) graduating with an M.Sc. in 1955. He was involved in soil survey in various parts of New Zealand, spent from 1964 to 1966 in Malaysia managing soil survey teams, and became Chief Pedologist in Soil Bureau when Harry Gibbs resigned to take up a position in the University of Waikato. In 1971 Mike Leamy spent six months on a Fellowship in South Africa, was awarded a D.Sc. from Victoria University of Wellington in 1976, was President of the New Zealand Society of Soil Science 1976-78, and became Director of Soil Bureau in 1981. Dr Leamy keenly promoted the trial of "Soil Taxonomy" in New Zealand. The intention of "Soil Taxonomy" was to provide a classification of the soils of the United States of America and subsequently there were various attempts to promote this classification for use elsewhere in the world, partly through a series of international committees (ten in all) equivalent to ICOMAND. Ultimately "Soil Taxonomy" was recognized as an international system of soil classification comparable to WRB. In New Zealand there was critical comment from two pedologist working in the universities and they wrote satirical commentaries along the lines of the "Conversations in Taxonomy" Gibbs (1982), Cutler (1982).

Eddie Cutler had been reviewing various soil classifications from elsewhere in the world and his ideas on a revised classification for New Zealand and he recorded these in an Occasional Report (Cutler, 1983). It was to be regretted that this report did not receive wider circulation at the time, but it is cited in Hewitt, Balks and Lowe (2021). In part of Cutler's report there is a full consideration of many soil classifications including "Soil Taxonomy". Cutler concluded that there was still a need for the revised New Zealand soil classification and in part two of the report he sets out his ideas. In his summary, Cutler makes the following observation: "In particular the use of concepts of

profile form is considered to be of fundamental importance in the development of a pedological classification for it is the profile which is the subject of study in the long run". In early 1981, a conference on 'Soils with Variable Charge' was held at Massey University, Palmerston North. As part of this international meeting there were field trips held in the North Island and South Island. Among the participants were Dr Richard W. Arnold and his wife. He was the newly appointed Director of Soil Correlation and Classification for the United States Department of Agriculture Soil Conservation Service. Arnold was born in Creston, Iowa, in 1929, served in the US Navy 1948-49, graduated B.S. from Iowa State University in 1952, worked as a student trainee and then full time on soil surveys 1952-55, and then moved to Cornell University as a soil technician working on soil surveys and graduated M.S. in soil genesis in 1959. The Arnolds then moved to Iowa State University where Richard Arnold graduated Ph.D. in 1963 and then on to University of Guelph, Ontario, 1963-66, teaching physical geography and soil genesis. In 1966 he moved to Cornell University as Associate Professor and Professor in Soil Science from 1966 to 1980. While at Cornell he worked with USAID to improve "Soil Taxonomy" and foster soil management transfer to tropical regions. In 1980 Dr Richard Arnold moved to the Soil Conservation Service of the Department of Agriculture in Washington as Director of Soil Correlation and Classification and subsequently became Director of the Soil Survey Division until 1996. From 1996 to 2000 he served as a special assistant to the Chief of National Resource Conservation Service and then to the Deputy Chief for Soil Survey and Resource Assessment, retiring in 2000. From 1972 to 2000 he made 40 international trips in soil outreach to soil scientists world-wide. In 2018 Dr Richard Arnold was the 5th Guy Smith Awardee, and in the citation for this award it was stated that "many soil classifiers from around the globe look to Richard (Dick) Arnold as their inspiration".

In 1979 Allan Hewitt was awarded a National Research Advisor Council Fellowship to begin studying for a Ph.D. at Cornell University, Ithaca, New York State (New Zealand Soil News, 1979). At that time Professor Richard Arnold was the expert on soil classification and soil survey. I am sure his presence, or at least his advice, would have influenced the decision that Allan made to attend Cornell University's Department of Agriculture. As fate would have it, Professor Arnold moved on to the Soil Survey of the Department of Agriculture about the time Allan and family arrived in the United States. The role of principal advisor for Allan's Ph.D. study program fell to Professor Armand R.H. Van Wambeke. Dr Van Wambeke was born in 1926 in Ghent, Belgium. He studied tropical agriculture at the University of Ghent from 1945 to 1949. He was a representative basketball player at the London Olympics in 1948. After military service, Van Wambeke worked as a soil surveyor in Belgian Congo, Rwanda and Burundi from 1951 to 1960, and this work formed the basis for his doctorate from the University of Ghent in 1958 on the properties and classification of central African soils. He subsequently expanded this work on Ferralsols for the United Nations Food and Agriculture Organization. Dr Van Wambeke had a number of assignments around the world: University of Congo 1960-61, UNFAO Colombia 1961-64 and Nepal 1965, an interim position as International Professor Cornell University and after that he returned to Latin America as a regional soil survey officer for UNFAO. In 1970 he returned to the University of Ghent as project leader for the soil survey programme. In 1976 he took up a position of Professor of International Soils at Cornell University until his retirement in 1995. He made contributions to teaching and research on tropical soils their appraisal and classification and for ten years supported international outreach of the United States Soil Survey. He was an early adopter of the use of personal computers and geographic information systems. He authored a book on the

geography, properties and management of tropical soils which was later adapted by the UNFAO Soil Map of the World international soil classification (WRB). He was remembered for a favourite saying: “To make progress in soil science one must go outside of it.” Professor Van Wambeke died in 2010. Allan Hewitt completed his Ph.D. in late 1982 with a dissertation entitled “Decisions in the establishment of soil series”. On the return of the Hewitt family to New Zealand, and Allan to the Soil Bureau, he was tasked with preparing a revised soil classification for New Zealand. This was to occupy Dr Allan Hewitt for more than ten years, the first edition of the “New Zealand Soil Classification” being published in 1992. It was reviewed at the time by Lowe (1992). The rest of this story is to be found in the obituary prepared by his colleagues (Aislabie et al., 2022).

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News from the regions

Waikato/Bay of Plenty

Plant & Food

Steve Green travelled to Italy in May 2022 to install equipment in kiwifruit orchards field trials for a Zespri funded project examining irrigation requirements of kiwifruit vines. While in the field, he recorded this YouTube video clip explaining the research and field instrumentation.
Special kiwiclick KVDS - IRRIGATION (ING) - YouTube

Water in the Hyper-Arid Emirates
Plant & Food Research have been working in the United Arab Emirates since 2013 with Environment Agency – Abu Dhabi (EAD) under a Government-2-Government Agreement. The projects have involved **Brent Clothier, Steve Green**, and Lesley Kennedy of OnlyFromNZ who manages the projects. Two large projects have been completed, and the Emirati lead scientists have graduated with their PhDs from Massey University. Brent, Steve and Lesley are still involved in one large project with EAD with yet another Emirati researcher, PhD student Mansoor Khamees Al Tamimi who is registered with Massey University. In August Mansoor visited Palmerston North to meet with supervisors Brent Clothier (PFR) and Paul Kenyan (Massey University). Mansoor is based in Abu Dhabi, in the United Arab Emirates (UAE), and his research project is working to solve the issue of food security and water conservation in one of the hottest climates in the world. More details on Mansoor's project are available at: Massey PhD student working to increase food and water security in Abu Dhabi

The first PhD graduate under the Government-2-Government Agreement was Wafa Al Yamani. She has just been interviewed by The National, the Emirates largest newspaper. Her story is at: https://www-thenationalnews-com.cdn.ampproject.org/c/s/www.thenationalnews.com/weekend/2022/07/15/emirati-researchers-technique-can-reduce-tree-irrigation-up-to-70-per-cent/?outputType=amp

It's a great read …
The Emirati researcher who's revolutionising forestry
Dr Wafa Al Yamani's work is taking the water out of growing trees in hot climates. In the 1960s, under the direction of the UAE's Founding Father, the late Sheikh Zayed bin Sultan Al Nahyan, a project began in Abu Dhabi emirate that would ultimately lead to the planting of about 19 million trees, most of them native species. A major legacy of Sheikh Zayed's leadership is the greening of the desert. The scheme changed the face of large tracts of land, with forests now covering about 3.5 per cent of the emirate, according to the Environment Agency Abu Dhabi (EAD). These efforts, however, continue to rely on irrigation, creating challenges for a country where water resources are limited.

Surviving a hyper-arid region

Through a tie-up with scientists in New Zealand, an Emirati researcher, Dr Wafa Al Yamani, has successfully introduced technology in the UAE that significantly reduces the amount of water given to each tree.
“These forests, they have importance for us, because they are the precious legacy of our Sheikh Zayed, as well as providing so many ecological services within the area,” she said.

“At the same time, because they are all planted, and they are in a hyper-arid region, in the desert … they need to be irrigated.”
Dr Al Yamani was an EAD employee when she began collaborating with researchers at Massey University in New Zealand. Through these links, she went on to begin a PhD in the Emirates, funded by the UAE but under the guidance of academics at the university.

A key part of Dr Al Yamani’s doctoral studies was to use “heat pulse” technology in the UAE that the New Zealand scientists had developed. Carried out at locations including the Khub Al Dahs forest near Madinat Zayed in Al Dhafra Region, formerly known as the Western Region, this work involved Dr Al Yamani implanting trees with tiny needle-like sensors that record the temperature every 30 minutes.

Focusing on native species
The focus was on native trees such as Ghaf, Sidr, Samr and Arak, because these account for well over 80 per cent of the forest area. Adapting the heat pulse technology to the extreme climatic conditions of the UAE was not easy. It had not been used in the GCC before and many probes and sensors struggled in the country’s hot and saline conditions. Readings from the temperature sensors help researchers to work out how much water a tree takes up from the ground, which in turn indicates the minimum amount it needs.

A host of factors including the size, age and type of tree, the soil type and the season influence requirements. Once a tree’s needs are calculated, about 20 per cent is added as a safety margin.
“Running these experiments for around three to four years allows us to have a really good amount of data that we use later on in our modelling to cover all the forests in Abu Dhabi,” Dr Al Yamani said.
“By that we know we could save around 35 per cent to 70 per cent of water in this new plan compared to the older practice.”
This is of vital importance because irrigation depends on groundwater, reserves of which have been put under increasing pressure as the population of Abu Dhabi grows.

Green goals
EAD has ambitious targets to cut water use in forestry, which has reportedly consumed as much as 11 per cent of Abu Dhabi’s water budget. Another key aspect of Dr Al Yamani’s research looked at using treated sewage effluent instead of groundwater for irrigation. Trees were found to thrive on the treated effluent. During her doctoral studies, Dr Al Yamani travelled to New Zealand two or three times a year for exams and presentations, while her supervisor, Dr Brent Clothier, made trips in the opposite direction with his research team. After successfully completing her research, which resulted in the publication of five main scientific papers, Dr Al Yamani was awarded her PhD at a ceremony in New Zealand about two years ago.

She travelled with her father, Faisal Al Yamani, and took along a UAE flag to mark her achievement in becoming the first Emirati to secure a doctorate from Massey University.

“I had to make up a very huge UAE flag,” she said. “When I went, the New Zealanders or, as they call themselves, the Kiwis, they are really very friendly people. Our relationship with them is not only as academics or scientists or international experts, it’s more kind of a second family.

“At that ceremony, the UAE flag was raised in a ceremony for the first time since the establishment of Massey University, which is more than 80 years [old]. I felt so honoured and blessed to have that kind of moment through my graduation.”

Other Emirati postgraduate students have followed in Dr Al Yamani’s footsteps, with one already having completed PhDs at the institution, and another underway.

Pastures new

Dr Al Yamani’s own career, however, has taken a new turn. She completed a diploma in international relations and diplomacy and plans to forge a career representing the UAE abroad.

“I like representing my country all over the world and I wish to address some of the sustainability and environmental issues internationally,” she said.

“From time to time I would also of course be happy to work in the field, but this is not the main thing I am looking for in the future.”

She retains a strong sense of gratitude to her New Zealand supervisors, and to the UAE and its senior figures, particularly Sheikh Abdullah bin Zayed, Minister of Foreign Affairs and International Co-operation, whose signing of a memorandum of understanding with New Zealand developed ties that ultimately resulted in her doctoral studies, and Sheikh Hamdan bin Zayed, the Ruler’s Representative in the Al Dhafra Region, and the EAD chairman.

“I really, really appreciate what the government has done and encouraged me through all these years and how they recruited me since I was a student until now. I had so many experiences and so many unique opportunities that were given to me,” she said.

Dr Wafa Al Yamani, second from right, at her PhD graduation with her father, Faisal Al Yamani, second from left, her PhD supervisor, Dr Brent Clothier, left, Prof Peter Kemp, right, and two of Dr Clothier's grandchildren.

Dr Wafa Al Yamani drilling holes to take the temperature probe. Photo: Wafa Al Yamani

University of Waikato

Waikato has had numerous MSc student submissions of late, a credit to the hard work of students and their supervisors during the last two years of covid complications. Congratulations to **Wayne Hofmann** and **Zetang Hawng Dau** who have both recently submitted their MSc dissertations. Wayne's project: "**An evaluation of GPS technology: a tool to aid pasture management"** was supervised by **Tanya O'Neill**, Mark Neal (DairyNZ) and Simon Woodward (DairyNZ). Wayne received financial support from DairyNZ, NIWA, and the Waihi Agricultural Education Trust. Dau's dissertation investigated the "**Distribution of trace elements at Kukutaaruhe Gully, Hamilton, New Zealand"** and he was supervised by **Tanya O'Neill** and Reece Hill (Landsystems) (Figure 1). Dau, who is originally from Myanmar, graduate study has been supported by a Ministry of Foreign Affairs and Trade (MFAT) scholarship.

Figure 1: Dau and Reece contemplating slope (joking) at one of Dau's transect sites, Fairfield College, Kukutaaruhe Gully, Hamilton, New Zealand. Photo: Tanya O'Neill.

Big congratulations to **Tsitsi Chiwetu** for submitting her dissertation: "Does phosphate extract carbon from soil organic matter?". Tsitsi was supervised by **Louis Schipper** and **Charlotte Alster**, receiving generous financial support from Ballance Agri-nutrients.

We have been building up our greenhouse research efforts at Owl farm near Cambridge. **Aaron Wall** recently installed our methane sensor – not for measuring emissions from cows but from soils (Figure 2).

Figure 2: UoW methane sensor (vertical larger sensor) and little brother for carbon dioxide measurements at Owl farm.

Madison Farrant, a new MSc student of **Tanya O'Neill**, has received the prestigious New Zealand Post Antarctic Scholarship, which provides $10,000 in support of her Master's degree (Figure 3). Madison will join Tanya and two others this summer and travel to Cape Bird, Ross Island, Antarctica, and will investigate the role of summer meltwater in the transfer of contaminants (heavy metals, excessive N and P, microplastics) from penguin colonies out to sea.

Figure 3: Madison and Tanya, all smiles after Madison's success receiving the New Zealand Post Antarctic Scholarship. Photo: Antarctica New Zealand.

Big congratulations to **Leeza Speranskaya**, supervised by **Dave Campbell**, who was awarded the Waikato Regional Council – Waikato University water sciences prize for top student in level three water science papers (Figure 4). Leeza has just started her MSc research where she is investigating the hydrology and carbon balances of the internationally recognised Kopuatai peat bog. Leeza's research will be useful for predicting the effects of climate change on peatland carbon sinks and for informing the restoration of drained peatlands.

Figure 4: The Water Sciences Prize, established in 1990 by Sir Ross Jansen with the University of Waikato Earth Sciences Department, was presented to Leeza at a recent Waikato Regional council meeting.

Sadly, but with real excitement, we farewell two of our research fellows who have moved on to new permanent positions. **Charlotte Alster** will be joining the faculty at Lincoln University as a lecturer in Soil Biology in November and **Jordan Goodrich** will very shortly be a senior scientist in the LUCAS team at the Ministry for the Environment (Figure 5). Both Jordan and Charlotte came from the United States to work in **Louis Schipper**'s team and will be greatly missed but are now keen collaborators!

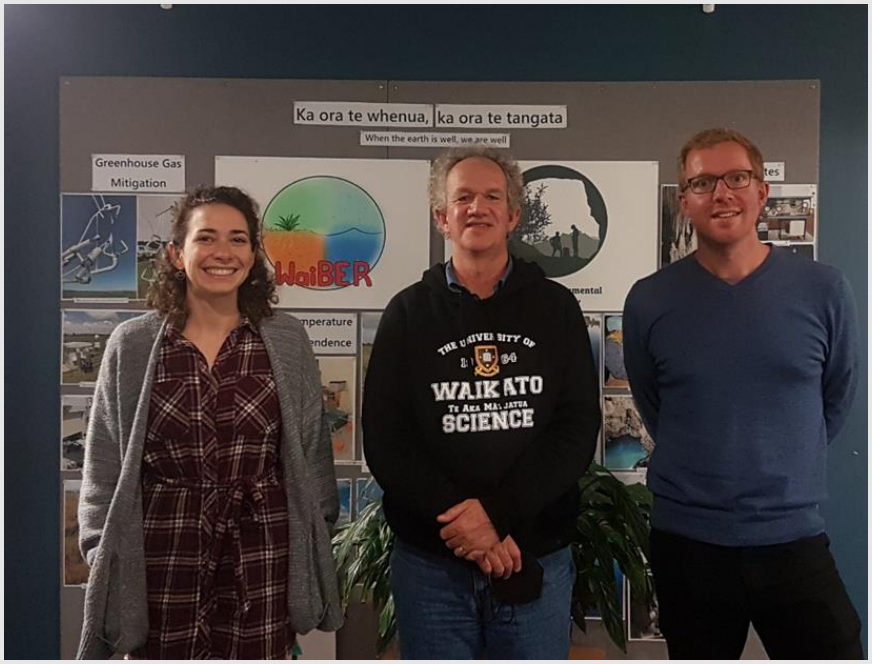


Figure 5: Charlotte Alster who is about to join Lincoln University, Louis Schipper and Jordan Goodrich who about the LUCAS team at MfE.

David Lowe participated in the 18th Quaternary Techniques Short Course "Measuring change and reconstructing past environment" held by GNS Science at the Avalon campus 3-5 August, 2022. Previously the course had been run in May over two days on the National Isotope Centre campus of GNS Science (at Gracefield, Lower Hutt), but Covid impacts saw it shifted to August and expanded to three days. David gave a talk on tephrochronology. The course comprised 21 presentations and seven lab tours and exercises. A total of 27 students attended (Figure 6). Peter Almond gave a talk on soil stratigraphy by Zoom. The course was convened by Georgia Grant, Claire Shepherd, Dan Lowry, and Joe Prebble.

Figure 6: Participants at the Quaternary Techniques Short Course 3-5 August, 2022. Photo: GNS Science

Waikato Regional Council

Matthew Taylor is getting this year's soil quality monitoring into gear and just about has the next stage of S-map for the region sorted. This is the west coast of the Waikato region, the last major area in the region remaining to be mapped and is likely to take about 5 years. Matthew is also involved in acid sulphate soils studies as these have become apparent due to climate change and drought drying soils deeper than in the past. The drying of deeper soil layers has allowed oxygen to penetrate into old marine sediments, oxidising sulphide minerals, with sulphuric acid being eventually washed out in drainage. This acidity has caused fish kills and damaged infrastructure.

Other research projects with recent reports include the Emerging Organic Contaminants programme with **Louis Tremblay** and **Grant Northcott** addressing the huge number of marketable chemicals (in the last year of programme funding there were 10 papers and a conference presentation being progressed for publication); the N mineralisation project with **Mike Beare** (the practical guidelines for soil N testing and predicting in-field N mineralisation are being drafted now); and the Manuka dominated ecosystems to improve water and soil quality at Lake Waikare with WRA and **Maria Gutierrez-Gines** (studies on plant and animal ecology, contaminant mitigation and effectiveness of riparian plantings). Matthew has about half a dozen significant consent applications and other smaller ones relating to land application of materials crossing or on his desk. Lots of time juggling involved.

Tim Norris is preparing the riparian survey to quantify the amount of fencing, vegetation and erosion present in streams, rivers and drains across the region. This is a major undertaking involving managing students, access, H&S in the field. Tim is also concerned about the lack of spring in the Bok after the third test.

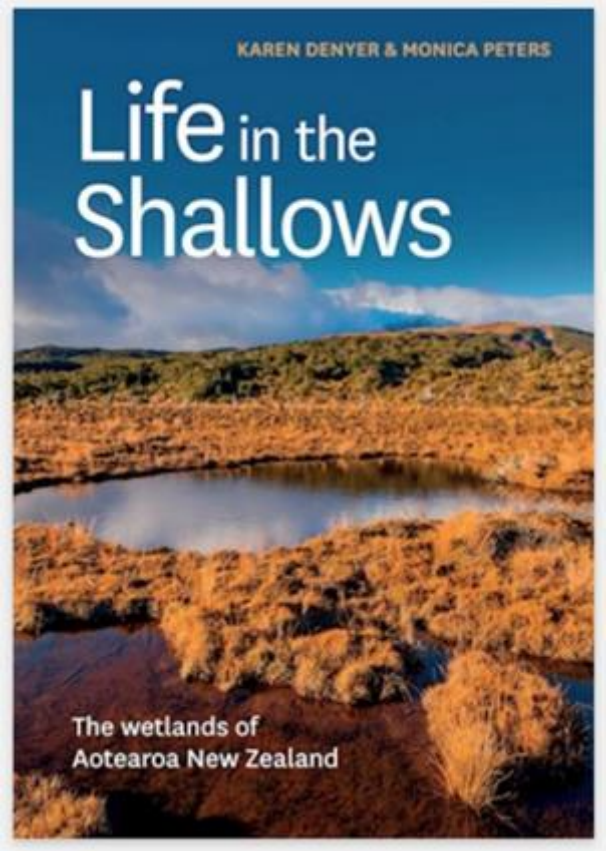
Justin Wyatt has reduced his hours to spend more time with his young family. He is still doing all things peat and helping Tim where necessary.

Haydon Jones is doing the team leader thing, protecting us from admin so we can get on with the job. We have just completed the recruitment to the Climate Impacts and Soil Response role. Haydon was very pleased to let us know that Alice Wheatley-Wilson will be joining our team on 22 August. Alice has an MSc from Waikato University, where she worked with Dave Campbell and others on temperature controls on CH_4 and CO_2 emissions from drained and intact peatlands.

Manaaki Whenua-Landcare Research

Bev Clarkson, **Corinne Watts**, **Suzanne Lambie** and **Yvonne Taura** have been honoured to be part of "Life in the Shallows". The book, written by **Karen Denyer** and **Monica Peters**, is a beautifully presented exploration of Aotearoa's wetlands drawing on the experiences of 17 New Zealand researchers.

Karen and Monica say *"The book is part human interest, part science and part travel guide. We hope people enjoy the stories about what wetland scientists do and along the way learn some fascinating things about our wetlands. We also hope they will visit the wetlands profiled in the book to experience these magical places. Ultimately, we want more people to understand and appreciate wetlands, and hopefully also inspire a new generation of wetland scientists".*



Bev is featured in the 'Fire and water' chapter on how fire creates and disrupts wetlands. Corinne is featured in the 'The tiny majority' chapter on wetland

restoration for native invertebrates. Suzanne is featured in the 'Working wetlands' chapter on microbial diversity and function in constructed wetlands. Yvonne is featured in the 'Weaving knowledge systems' chapter on blending cultural and western ecological knowledge for wetland protection and co-wrote an introduction to wetlands through the lens of Te Ao Māori. The book is available from the New Zealand Wetland Trust website and proceeds go towards supporting the Trust's wetland advocacy work https://www.wetlandtrust.org.nz/latest-news/.

Suzanne Lambie and **Jo-Anne Cavanagh** (MWLR Lincoln) are measuring trace element accumulation and carbon and nitrogen cycling in natural and constructed treatment wetlands. Wetlands are more likely to accumulate trace elements from adjacent land uses and may be more sensitive to the negative impacts of high levels of trace elements. They will be working in urban wetlands in Wellington and rural wetlands in the Waikato and Bay of Plenty areas investigating the impact of urbanisation, intensive grazing and kiwifruit production on wetland trace element levels, microbial populations and processes.

Bryan Stevenson left Manaaki Whenua in June for a new opportunity in the USA. He has contributed greatly over many years to regional council soil quality monitoring programmes, regional and national reporting, associated research, and many other soil research programmes. Bryan co-led the 'Soil health and resilience: oneone ora, tangata ora' research programme funded by MBIE. Bryan has ongoing links as he will be a Research Associate with Manaaki Whenua.

Manawatu

Manaaki Whenua – Landcare Research

Lauren O'Brien and **Anthony Ward** commenced S-map fieldwork for soil mapping of the Taranaki region (see photo). The S-map work in the upper Manawatu region is continuing. The soil mapping for the Horowhenua region was completed, and will be made available through S-map on-line. **Shana Dooley** transferred to our Lincoln office. Shana has picked up many skills while working in soil pedology, field soil surveys, legacy data and carbon sampling.

Photo: A soil profile of a Typic Orthic Allophanic Soil, showing debris flow material over tephra, near Stratford, Taranaki, for S-map fieldwork. Photo: Lauren O'Brien.

Massey University

Advanced Farm Environment Planning courses running

After Covid disrupted the second semester course last year, the Massey University team of **Lucy Burkitt**, **Mike Bretherton**, **Alan Palmer** and new staff member **Callum Rees** were pleased to run our second official Advanced Farm Environment Planning Course field trip in late June. They visited 3 farms around the Manawatu region, covering arable, beef and sheep and dairy operations. The field trips were a great opportunity for students to get out on farm and speak with the farmers about their farming operation. The students then walked the farms to observe the farm landscape, soils, critical source areas, waterways and other physical features and farm management practices that are important to consider when the students develop Freshwater Farm Plans for the 3 farms. Both the Advanced and the Intermediate Farm Environment Planning courses aim to develop the skills and knowledge needed by rural professionals to deliver the Governments Essential Freshwater policies and to support farmers to develop robust and effective Freshwater Farm Plans which address Te Mana o te Wai.


Photos. *Left: Mike Bretherton (Massey University) discussing the properties of a dairy farm soil with Advanced Farm Environment Planning course students, Right: Advanced Farm Environment Planning course student conducting a soil texture test. Photo credits: Lucy Burkitt.*

Highlights from the Taranaki ReGen Hui

A team of scientists from the School of Agriculture and Environment (SAE) joined the two-day (June 30, July 1) Taranaki ReGen Hui at Inglewood Event Centre. **Lucy Burkitt**, **Roberto Calvelo-Pereira, Ignacio Lopez**, **Jonathan Procter**, **Mike Smith**, **Moutasim Jebrell** and **Ben Carter** joined the event, focused on exploring further opportunities for Regenerative Agriculture in Taranaki. Other participating researchers included **Gwen Grelet** and **Paul Mudge** (Manaaki Whenua – Landcare Research), as well as **Syrie Hermans** (Auckland University of Technology – AUT). The event was part of a new Pivot – Enabling Innovation in Agriculture: Bashford-Nicholls Trust – Massey University Premier Research Award which is led by **Eve Kawana-Brown** of Massey University and Venture Taranaki, **Lucy Burkitt** and Taranaki Regenerative Agriculture Advocate, Catalyst and Coordinator **Fiona Young.** The Hui was facilitated by **Annie Perkins** (Groundwork Associates).

The meeting benefited from the presence of multiple stakeholders, including leading farmers practising regenerative agriculture in Taranaki, as well as guest farmers and regenerative ag coach and educator from Upper Hutt Jules Matthews (Integrity Soils) and Mark Anderson (regenerative dairy farmer from Otago), as well as Mana Whenua representing Parininihi ki Waitotara (PKW), Pounamu Skelton, national co-chairperson of Te Waka Kai Ora, Glen Katu from MPI Maori Agri Business and Whenua Ora, The Massey Agri/Whenua Haumanu Team, Fed Farmers, Dairy NZ, Taranaki Regional Council, Forest and Bird - Regional Lead, The Department of Internal Affairs, Venture Taranaki, High School and Adult Education Ag/Hort Teachers, Soil Food Web NZ, Farm advisors, among others.

This Hui was a great opportunity to bring farmers, advisors, and scientists together to discuss multiple aspects around regenerative agriculture in the Taranaki area, facilitating fruitful dialogue and collaboration between the people attending. A combination of presentations, activities and exchange of experiences fulfilled and

agenda aiming to identify 'on farm' measures that have potential to make a positive difference in Taranaki. The hui focussed on what information matters to farmers in terms of supporting their decision making in the context of regenerative management, as well as how to provide evidence of effective change beyond the farm business.

Update: Farmed Landscapes Research Centre Annual Workshop

The Farmed Landscapes Research Centre (FLRC) 35th Annual Workshop will be held 8th-10th February 2023 at Massey University. The Workshop title and themes, along with a call for abstracts, will be in your inboxes within the next few weeks. Please contact Christine at C.L.Christensen@massey.ac.nz if you or your colleagues wish to be added to our address database to receive Workshop updates.

AgResearch

There's a new scientist in Land Use Function & Evaluation Team. **Duy Tran** has a broad background in geography, geospatial technologies, and natural resource management. He specialises in applying GIS and remote sensing in environmental monitoring and assessment. His work has involved spatial data collection, analysis, and visualization, multispectral image processing and analysis, land cover mapping and evaluation, land use planning and management, and ecosystem services modelling. His PhD research focuses on the integration of ecosystem services approach and geodesign to develop multifunctional agricultural landscapes in the New Zealand hill country. Prior to coming to New Zealand in 2019, he was a geography lecturer at Hanoi National University of Education, Vietnam where he spent almost ten years teaching GIS and Remote sensing.

AgResearch Grasslands Exploring Regenerative Grazing Practices

From discussions with a group of farmers who are either exploring or who have adopted regenerative farming practices, a common interest was investigating more about the practice of maintaining a higher than currently recommended pasture cover in rotational stocking systems (both pre- and post-grazing), in conjunction with high stocking intensities during grazing.

With funding from MacDonalds Restaurants New Zealand, Greg and Rachel Hart the owners of Mangarara Farms, input from John King and farmer group and the research team that includes staff from AgResearch (Alec Mackay, Gerald Cosgrove, Brian Devantier, Emma Noakes) and a Master student from Massey (Zachary Dewhurst) a grazing experiment has been established on Mangarara Farms to investigate the impact the practice of maintaining a higher than currently recommended pasture cover in rotational stocking systems (both pre- and post-grazing), in conjunction with high stocking intensities during grazing, has on pasture and animal production, nutrient requirements, environmental footprint and the resilience of the system.

Following the identification of the area for the study (see photo) in December 2021, the trial site was mapped using a Trimble R8S Base Rover System which was uploaded to Geographical Information System (GIS) software to develop a detailed digital elevation model (DEM) of the paddock and to calculate the size and number of the cells (the unit of area for pasture allocation) for the comparison of the two grazing treatments using cattle (i) Adaptive grazing treatment and (ii) Control grazing treatment. At the same stocking rate for each treatment, the Adaptative treatment animals are offered a fresh cell three times per day, whereas the Control animals are offered one cell every three days. Compared with the Adaptive treatment described above, the Control treatment follows typical pre-grazing and post-grazing herbage mass.

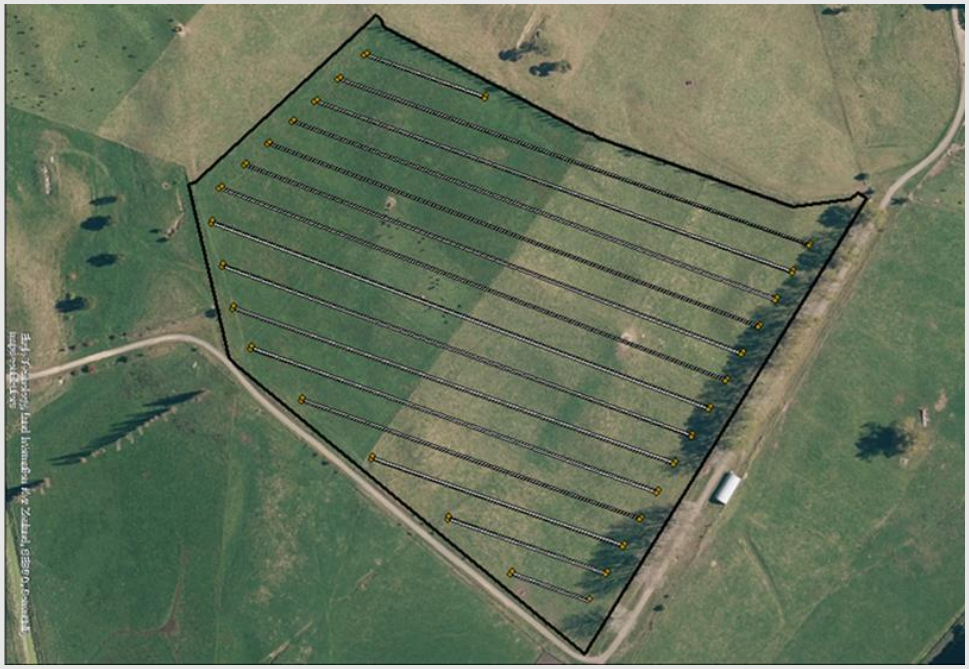


Photo: Aerial photo of the field experiments where the two grazing practices are being compared.

The field experiment, which started in May 2022, following the collection of baseline data and information, is currently being grazed for the second time. Measurements include pasture growth, composition and quality, litter return, soil temperature and moisture, liveweight gain of the beef cattle, soil health (includes nutrient fertility, biological activity, physical condition and organic matter content and quality) and soil organic carbon stocks.

Zachary Dewhurst the Master of Science post-graduate student from Massey University with **Lucy Burkitt** as his supervisor, is comparing the effects of grazing behaviours on the spatial distribution of dung and urine return under the adaptive and control grazing treatments. Zachary is also undertaking some preliminary method development work on the use of a drone, with a range of sensors to identify dung and urine patches.

Canterbury and Otago

Manaaki Whenua – Landcare Research

Veronica Penny and the team from the National Soil Carbon Monitoring programme have been busy sampling (see photos).

“Scenes from a recent sampling trip to Marlborough with Hamish Maule, as part of the National Soil Carbon Monitoring programme. Great to see some of the landowners so engaged and interested in what we were doing!”

AgResearch

Nicole Schon (AgResearch) has been working with **Lisa Hsu** and **Roger Hill** (RJ Hill Laboratories) in a project funded by OLW to develop a molecular test to assess earthworm abundance and diversity. They have been able to identify and design suitable primers and probes for the most common earthworms found within each earthworm ecological group in New Zealand (e.g. *Lumbricus rubellus* as epigeic, *Aporrectodea caliginosa* as endogeic and *Aporrectodea longa* as anecic). Initial soil samples collected showed good correlation between Real-Time PCR (RT-PCR) and morphological assessment. Further samples collected reduced the strength of correlation between molecular and morphological assessment of earthworms and investigation into factors causing this are ongoing. However, the test was sensitive to changes in earthworm abundance at individual sites. They continue to assess earthworm populations to build up a data set correlating molecular and morphological information.

Book review – "Turning the sods"

"Turning the sods, a collection of columns", by Doug Edmeades ONZM

Last Side Publishing Ltd, Hamilton NZ. 220p. ISBN 978-0-473-60885-9.

In reviewing this book, I think it is important to start with some background. Doug Edmeades was brought up on a dairy farm in the Waikato where the great contribution that the Ruakura Agricultural Research Station made to NZ Agriculture in the 1950s and 60s was part of his orbit. Science was important and it made a difference! A bright student, Doug studied science at Auckland and Canterbury Universities. He then joined the staff of MAF at Ruakura where he felt he could contribute to the exciting work of public-good science to support NZ farmers and to help NZ remain a world leader in Agriculture. By 1990 he was the MAF National Science Leader in Soils and Fertilisers, leading a strong group of scientists with good technical support.

However, in 1997 Doug left institutional science, having become "disillusioned with the increasing commercialisation and politicisation of science and the increasing gap between the scientist and the farmer". The pivotal event that changed Doug's career, and to some extent the course of NZ science, was the so-called "Maxicrop saga". For those who do not remember this case I think it is worth revisiting as it underlies all that Doug has worked for since, and it is part of NZ history that all those working in NZ science, and soil science in particular, should be aware of.

In short: Maxicrop was an expensive product, heavily marketed to farmers in the 1980s as a liquid fertiliser concentrate. Maf Technology undertook a series of experiments that showed that Maxicrop had no measurable effect on plant growth. Doug, and colleague Bert Quinn, felt that NZ farmers should get the message that their money was being wasted and so went to the "Fair Go" TV programme with their story. The upshot was that the manufacturers of Maxicrop went broke and sued MAF for defamation. At the time the court case became New Zealand's longest running. The judge found, in MAFs favour, that Maxicrop did **not** work. However, the cost of defending the case was astronomical and not recoverable. Ever since, even when clearly on the side of right, scientific organisations have been highly deterred from allowing staff to speak out to criticise "snake-oil merchants", and the like, for fear of the cost of being sued. Doug wrote about the Maxicrop case in another book, "Science Friction". He continues to be fearlessly outspoken, endeavouring to help farmers determine fact from fiction, science from pseudoscience, in the confusing mass of fertiliser promotion as well as wider agricultural issues.

Those of you who read the weekly farming press will be familiar with Doug's long-time (unpaid) contributions – always clear, well informed, sometimes funny, fearless, and often driven by a white-hot anger at the abuse, misuse, and ignorance, of science in some modern media reporting. "Turning the Sods" brings together a collection of these writings. Each of the 100 or so columns is short, and can be read alone. They deal with the issues of soils, agriculture, the environment, and the wider philosophy of science. Written in plain English, I found every one of them entertaining and thought provoking, even if I did not always agree with everything that was said. These articles are strong statements on topics of global importance. While I enjoyed reading them, I

found that I could never read more than a few in a sitting – I had to let it go after a while, to absorb and consider the information, and to let my blood pressure reduce (the underlying anger can be contagious). But I always went back for more, and will continue to reread many from time to time.

Overall, this book is a love letter to science and the promise of hope for humanity that good science, and agricultural science in particular, holds. It also includes a surprisingly personal account of Doug's battles with himself and the world. "Turning the Sods" is a warning about how we need to defend science from the drivers of money, ego, fear, and politics. A book I highly recommend. As Jock Allison commented "there should be a copy on the desk or bedside table of all farmers, agricultural professionals, and students".

"Turning the sods" is available for purchase for $35+GST and postage from www.agknowledge.co.nz/publications

Dr Megan Balks

Update from Soil Science Australia

Smart Farms Smart Soils

Soil Science Australia has established a 'Smart Farms Smart Soils Community of Practice' bringing together the Drought and Innovation Hubs from across Australia, soil scientists, researchers and government to collaborate, network, learn and share knowledge. Further information and resources will be available through our website shortly. This work is supported by the Australian Government's Smart Farms Program.

Protecting soils protects our future

Soil Science Australia is delivering a range of projects and collaborating with industry and researchers to improve Australia's soil health.

The Australian Government's National Soil Package helps deliver the National Soil Strategy:

- ensuring our soils are valued, managed sustainably, and
- improved so that they continue to contribute to agricultural productivity, environmental sustainability, and economic growth.

'Strengthening soil knowledge and capability' is one of the main goals of the National Soil Strategy.

The Smart Farms Smart Soils (national soil science extension) and the Registered Soil Practitioner (training and accreditation) programs SSA are being delivered with the support of the Australian Government to aid this goal.

Audio visual

The secrets of soil and how it shapes our lives

Australian soil scientist Alisa Bryce describes soil as a wonderful mysterious world, an underground jungle, a nexus of a portal between life and death.

https://www.rnz.co.nz/national/programmes/ninetonoon/audio/2018852910/the-secrets-of-soil-and-how-it-shapes-our-lives

News from the European Soil Data Centre

Satellite-based Global Erosivity dataset

A satellite-based R-factor dataset is available using the high spatial and temporal resolution global precipitation (30 min) estimates obtained from the National Oceanic and Atmospheric Administration (NOAA) and applying the Climate Prediction Center MORPHing (CMORPH) technique. Alternatively, the erosivity density (ED) concept was also used to estimate global rainfall erosivity. The obtained global estimates of rainfall erosivity were validated against the pluviograph data included in the Global Rainfall Erosivity Database (GloREDa). In this study, we found that the CMORPH estimates have a marked tendency to underestimate rainfall erosivity when compared to the GloREDa estimates. The most substantial underestimations were observed in areas with the highest rainfall erosivity values. Data available at: https://esdac.jrc.ec.europa.eu/content/global-rainfall-erosivity

Soil Mission–10 calls for proposals are open

Three calls are currently open till 27 September 2022. Funding tenders for 95 Million Euros: Network on carbon farming for agricultural and forest soils, Citizen science for soil health, Soil biodiversity and its contribution to ecosystem services, Building the mission's knowledge repository and advancing the EU Soil Observatory, Improving food systems sustainability and soil health with food processing residues, Innovations for soil improvement from bio-waste, Monitoring-reporting and verification of soil carbon and greenhouse gases balance, Foster soil education across society, Remediation strategies, methods and financial models for decontamination and reuse of land in urban and rural areas.

Further details are available from: http://esdac.jrc.ec.europa.eu

Abstracts

Tillage practice and sowing time affect yield, nitrogen uptake and profitability of catch crops sown after winter forage grazing in New Zealand

Eight oats catch crop trials were conducted over two years on winter forage paddocks on commercial dairy farms in Canterbury and Southland measuring the effect of tillage and timing-by-tillage, respectively, on dry-matter (DM) yields, N uptake and profitability (gross profit margin). The main objective was to successfully integrate catch crops into winter forage rotations over a critical period when the soil is normally bare and the potential for N drainage loss from urinary-N deposition is high. Oat harvest yields at green-chop silage maturity (~50% panicle emergence) ranged from 8 to 10 t DM/ha when sown by the end of winter (4-5 months after drilling). Nitrogen uptakes ranged from 52 to 363 kg N/ha. Net gross profit typically ranged from NZ$1000 to NZ$1600/ha (assuming revenue of

NZ$0.20/kg DM for standing feed). Minimum-till cultivation produced higher DM yields than direct-drill treatments in both years of the Canterbury trials (~30% higher overall) but where N availability and good soil-seed contact were maintained, differences in yield were small (~5%). Earlier sowing in Southland using a spader-drill combination increased DM yields and N uptake overall by 123% and 48%, respectively, over later sown conventional tillage options.

Carey PL, Malcolm BJ, Maley SC 2022. Tillage practice and sowing time affect yield, nitrogen uptake and profitability of catch crops sown after winter forage grazing in New Zealand. New Zealand Journal of Agricultural Research: 1-25. On-line early.

Measuring and modelling nitrate fluxes in a mature commercial apple orchard

Leaching of nitrogen from intensive agriculture to groundwater and waterways is a source of environmental harm. Nitrate leaching beneath a commercial 10-year-old 'Galaxy' apple orchard was investigated using a combined measurement and modelling approach. Measurement of sapflow, climate, soil moisture, deep drainage and nitrate leaching beneath the root zone were monitored for 30 months in order to parameterise and calibrate the Soil Plant Atmosphere System Model (SPASMO). Sap flow peaked at around 15 L tree^{-1} day^{-1} in late January with average sap flow for the 2013/14 season of 8.58, 6.39 and 6.47 L tree^{-1} day^{-1} for the high (4.0 L ha^{-1}), medium (2.3 L ha^{-1}) and low (1.6 L ha^{-1}) irrigation treatments, respectively. Deep drainage and nitrate leaching were highly variable and did not appear to be influenced by irrigation rate. Over the 30-month monitoring period, drainage beneath the rootzone averaged 89 mm yr^{-1}, whilst nitrate leaching averaged 33.2 kg-NO3 ha^{-1} yr^{-1}, equivalent to 55% of the applied fertilizer. Average nitrate concentration in the leachate exceeded the World Health Organisation threshold for drinking water of 50 mg L^{-1} in 41 out of 279 samples. Long-term modelling indicated the average amount of drainage and nitrate leaching were 136 mm yr^{-1} and 11.4 kg-NO3 ha^{-1} yr^{-1}, respectively. Scenario analysis indicated that few options existed to reduce nitrate leaching at the site through irrigation and fertigation management.

Hardie M, Green S, Oliver G, Swarts N, Clothier B, Gentile R, Close D (2022) Measuring and modelling nitrate fluxes in a mature commercial apple orchard. Agric Water Manage 263. doi: https://doi.org/10.1016/j.agwat.2021.107410

Evapotranspiration and crop coefficients using lysimeter measurements for food crops in the hyper-arid United Arab Emirates

In the hyper-arid United Arab Emirates (UAE) irrigation is needed for food crops because there is limited rainfall of less than 100 mm y^{-1} in the crop-growing parts of the UAE. Groundwater is the main source of irrigation water, yet it is a declining resource both in terms of quantity, and quality as a result of rising salinity. Law 5 has been passed by the Government of Abu Dhabi to manage groundwater extraction by limiting water takes to an amount that is considered to be sufficient to grow a given crop. In order to allocate these water takes, the Environment Agency – Abu Dhabi sought experimental data and a model platform to calculate equitable allocations for each vegetable crop. We designed simple weighing lysimeters to measure directly the water-use lettuce, capsicum, tomato, cucumber and zucchini grown in the field, as well as in a shadehouse and a cooled greenhouse for capsicum, cucumber and tomato. Total crop yields were measured via progressive harvests through to the end of the growing season. The yields in the greenhouse were the highest. The crop water-use efficiency (WUE_C, kg crop per m^3 crop evapotranspiration ET_C) was three fold higher in the greenhouse (≈ 30 kg m^{-3}) than in the shadehouse or field (≈ 10 kg m^{-3}). However, when the water used to cool evaporatively the greenhouse was accounted for in the water productivity (WPI kg crop m^{-3} water for irrigation and cooling) there were no differences between the field, shadehouse and greenhouse. So whereas the farmer benefits from higher yields in the greenhouse, there is no advantage in terms of water productivity. However, use of alternative waters for greenhouse cooling, such as treated sewage effluent, could be used to protect groundwater. Our water-use data were used to calculate the seasonal pattern of the FAO56 crop coefficient, K_C, through the piecewise linear phases of crop growth, the initial (K_{Cini}), middle (K_{Cmid}), and the end (K_{Cend}) of the growing season. These KC values were compared with recent reviews of FAO56 for vegetables. Due to the various training systems for the crops in this study, the KC values varied considerably, with K_{Cini} ranging from 0.2 to 0.5, K_{Cmid} from 0.5 to 1.35, and K_{Cend} from 0.2 to 0.7. These K_C values will be used in our Crop Calculator Decision Support Tool (DST) to implement Law 5.

Tamimi MA, Green S, Hammami Z, Ammar K, Ketbi MA, Al-Shrouf AM, Dawoud M, Kennedy L, Clothier B (2022) Evapotranspiration and crop coefficients using lysimeter measurements for food crops in the hyper-arid United Arab Emirates. Agric Water Manage 272:107826. doi:https://doi.org/10.1016/j.agwat.2022.107826

System nutrient dynamics in orchards: a research roadmap for nutrient management in apple and kiwifruit. A review.

As agricultural intensification affects global environmental change, a redesign of our food production systems towards practices that replace external inputs with inbuilt ecosystem services is needed. Specifically, human-induced changes to biogeochemical flows of nitrogen (N) cycling exceed the proposed planetary boundaries, highlighting a priority area for reducing nutrient inputs in agricultural production systems. A new understanding of nutrient interactions in the complete agroecosystem will allow us to better predict and mitigate the consequences of

anthropogenic environmental changes compared with a reductionist approach. Here, we review for the first time system-level nutrient interactions, particularly N, in perennial horticulture using high-producing kiwifruit and apple crops grown in New Zealand as a basis to identify critical knowledge gaps and prioritize new research. The major points identified are (1) current nutrient guidelines are from the 1980s to the early 2000s and do not take into account substantial production changes since that time; (2) few studies construct complete nutrient budgets of all sources and losses; (3) nutrient loss estimates are generally low relative to those from other agricultural land uses; (4) there is a lack of studies which address nutrient interactions between above- and below-ground food webs in perennial horticultural crops; (5) there is contradictory literature where fertilizer has been found both to increase and to decrease plant chemical signaling and defense mechanisms. New tools are emerging to improve orchard nutrient management, including advances in fertilizer application techniques, new methods to monitor plant and soil nutrients, and utilizing genetic variability to breed cultivars with improved nutrient use efficiency. To reduce adverse nutrient effects on the environment, new research is needed, addressing the relationships between carbon and nutrients and nutrient demands in modern fruit cultivars and growing systems; the nutrient balance for perennial horticultural crops considering all inputs and outputs; and interactions of the above- and below-ground nutrient flows in orchard food webs.

Gentile RM, Boldingh HL, Campbell RE, Gee M, Gould N, Lo P, McNally S, Park KC, Richardson AC, Stringer LD, Vereijssen J, Walter M (2022) System nutrient dynamics in orchards: a research roadmap for nutrient management in apple and kiwifruit. A review. Agronomy for Sustainable Development 42 (4):64. doi:https://doi.org/10.1007/s13593-022-00798-0

Using drainage fluxmeters to measure inorganic nitrogen losses from New Zealand's arable and vegetable production systems

Commercial cropping farms in New Zealand (NZ) showed highly variable rates of nitrate-N leaching losses (13–148 kg/ha/year) across sites, cropping systems and seasons. Losses were measured at 1.2 m below the soil surface using a network passive-wick drainage fluxmeters (DFMs) which were installed across nine commercial farms between August 2014 and June 2016. Sites were located in the Canterbury, Manawatu, Hawke's Bay, Waikato and Auckland regions and monitored for a period 51 to 72 months. Twelve DFMs were installed at each site and drainage volumes were validated using an established soil water balance model. At seven sites, losses were calculated using measured drainage and measured concentrations, and at two sites losses were calculated using modelled drainage and measured concentrations. Nitrate-N was the predominant form of inorganic N (96.7–99.9%) in drainage water and annual losses averaged 52 kg/ha/yr for mixed cropping systems with livestock grazing (n = 6) and 101 kg/ha/yr for mixed cropping systems with a focus on vegetable production (n = 3). While not broadly representative of all NZ cropping land uses, results from this study do,

nevertheless, suggest that when drainage occurs, nitrate losses may be considerable under the land uses represented here (> 70 kg/ha/y).

Norris M, Johnstone PR, Green SR, Trolove SN, Liu J, Arnold N, Sorensen I, van den Dijssel C, Dellow S, van der Klei G and others 2022. Using drainage fluxmeters to measure inorganic nitrogen losses from New Zealand's arable and vegetable production systems. New Zealand Journal of Crop and Horticultural Science: 1-23. DOI: 10.1080/01140671.2022.2077771

Formation and mechanisms of nano-metal oxide-biochar composites for pollutant removal: A review

Biochar carbon-rich material, has been widely used to adsorb a range of pollutants because of its low cost, large specific surface area, and high ion exchange capacity. The adsorption capacity of biochar, however, is limited by its small porosity and low content of surface functional groups. Nano-metal oxides have a large specific surface area and high surface energy but tend to aggregate and passivate because of their fine-grained nature. In combining the positive qualities of both biochar and nano-metal oxides, nano-metal oxide-biochar composites (NMOBCs) have emerged as a group of effective and novel adsorbents. NMOBCs improve the dispersity and stability of nano-metal oxides, rich in adsorption sites and surface functional groups, maximize the adsorption capacity of biochar and nano-metal oxides, respectively. Since the adsorption capacity and mechanisms of NMOBCs vary greatly amongst different preparations and application conditions, there is a need for a review of NMOBCs. Herein we firstly summarize the recent methods of preparing NMOBCs, the factors influencing their efficacy in the removal of several pollutants, mechanisms underlying the adsorption of different pollutants, and their potential applications for pollution control. Recommendations and suggestions for future studies on NMOBCs are also proposed.

Chenxi Zhao, Bing Wang, Benny K.G. Theng, Pan Wu, Fang Liu, Shengsen Wang, Xinqing Lee, Miao Chen, Ling Li, Xueyang Zhang. Science of the Total Environment 767: 145305 (2021). https://doi.org/10.1016/j.scitotenv.2021.145305

Effect of irrigation on soil physical properties on temperate pastoral farms: a regional New Zealand study

Context. Many regions in the world have undergone rapid land use change and intensification of agricultural land, such as through irrigation expansion, upgrading irrigation systems, and changing grassland, stock, and nutrient management practices. With more intensive land use, changes to soil properties can occur, such as soil compaction and changes in soil water storage. The effects of modern sprinkler-irrigated pastoral farming on soil physical properties are not well quantified internationally, particularly for temperate climates. Aims. This regional study evaluates the effect of irrigation on soil physical properties in topsoil and

subsoil, under modern pastoral grazing and sprinkler irrigation, across Canterbury, New Zealand. Methods. Paired sites were sampled, consisting of a spray-irrigated paddock (field) and an adjoined part of the same paddock that was dryland (unirrigated), with other management the same for each pair. Key results. Under irrigation there was a shift towards a greater abundance of smaller pores. This was reflected in macroporosity and readily available water capacity being significantly lower under irrigation, while semi-available water capacity and unavailable water held below permanent wilting point both increased. Conclusions. These differences reflect increased compaction under irrigated grazed pasture, particularly under dairy grazing, consistent with findings in similar studies. This study quantified changes in both the topsoil and subsoil but showed that most differences were confined to the topsoil (30 cm depth). Implications. For irrigation management, our study indicates the lower readily available water capacity on irrigated pasture is significant, with farmers potentially having to irrigate more frequently. Adopting deficit irrigation could minimise impacts of compaction.

Drewry JJ, Carrick S, Penny V, Dando JL, Koele N 2022. Effect of irrigation on soil physical properties on temperate pastoral farms: a regional New Zealand study. Soil Research. Open access. On-line early. https://doi.org/10.1071/SR21254

HyPix: 1D physically based hydrological model with novel adaptive time-stepping management and smoothing dynamic criterion for controlling Newton-Raphson step.

The newly developed open-source Hydrological Pixel model, HyPix, written in the fast and flexible Julia language, efficiently solves the mixed form of the Richardson-Richards' equation (RRE). HyPix uses a cell-centred, finite-volume scheme for the spatial discretization, with an implicit Euler scheme for the temporal discretization, by using the weighted average inter-cell hydraulic conductivity. HyPix includes the following modules: (a) rainfall interception, (b) root water uptake with compensation algorithm and root growth, (c) soil evaporation, (d) ponding using a novel method for computing sorptivity, and (e) runoff. HyPix includes a wide range of top and boundary conditions (flux, pressure, free drainage). To control the Newton-Raphson iterations, HyPix incorporates a novel dynamic physical smoothing criterion, which improves not only the model performance but also its accuracy compared with using the traditional absolute convergence criterion. To control the time-step, the traditional physical time-step management based on changes in the soil water content was specifically designed to solve RRE based on soil water content. This work adapts the time-step management such that it is specifically designed to solve RRE based on soil water pressure without introducing further parameters. The novel time-step management also requires only one parameter and was found to be more efficient than the traditional time-step management. HyPix implements an option to solve the derivatives numerically, enabling the RRE to be modified and tested (e.g., the inter-cell hydraulic conductivity) by changing only a few lines of code. Numerically calculating derivatives was found to be as accurate as deriving the derivatives

analytically, and only 10–25% slower. The well-established hydrological model HYDRUS was used to validate HyPix without the sink term. The HyPix results show good agreement to HYDRUS, validating the algorithms implemented in HyPix. Even for challenging conditions, HyPix can provide accurate and reliable results using the recommended standard options. Moreover, the algorithm developed in HyPix is more efficient than the one used in HYDRUS, particularly for coarse texture soils. The recommended options were also tested by running HyPix with sink term using field data.

Pollacco JAP, Fernández-Gálvez J, Ackerer P, Belfort B, Lassabatere L, Angulo-Jaramillo R, Rajanayaka C, Lilburne L, Carrick S, Peltzer DA 2022. HyPix: 1D physically based hydrological model with novel adaptive time-stepping management and smoothing dynamic criterion for controlling Newton-Raphson step. Environmental Modelling & Software 153: 105386.

Maize cropping degrades soil hydraulic properties relative to grazed pasture in two contrasting soils

Soil hydraulic properties (SHPs), including available water content and near-saturated hydraulic conductivity (Kns), affect hydrological and biochemical processes. The SHPs information is crucial to agricultural water management. The objective of this study using paired sites was to investigate the effects of land use on SHPs in two contrasting soil orders. Soil water retention curves and Kns at three soil depths (0–10, 10–20 and 20–30 cm) were measured under two land uses (pasture, consisting of a rye grass [Lolium perenne L.] and white clover [Trifolium repens L.] mix, and maize [Zea mays L.] cropping > 10 years) in Waikato, New Zealand. For each land use, two soil orders with contrasting soil structural vulnerability were selected: less vulnerable Allophanic soil and more vulnerable Gley soil. Compared with pasture, maize cropping reduced macroporosity, readily available water capacity and Kns of 0–30 cm, and the effect was greater in the deep layer (20–30 cm). This indicated that maize cropping practices result in greater structural degradation to soils compared with pasture, which include the potential for greater subsoil compaction. There was no land use by soil order interaction effect on SHPs, suggesting that the relative SHP degradation under maize cropping compared with pasture grazing was not associated with soil structural vulnerability. Our study emphasised that long-term continuous cropping with maize on the more vulnerable soil (i.e. Gley soil) resulted in the poorest soil physical health.

Hu W, Thomas S, Müller K, Carrick S, Beare M, Langer S, Cummins M, Dando J, Fraser S, Stevenson B and others 2022. Maize cropping degrades soil hydraulic properties relative to grazed pasture in two contrasting soils. Geoderma 421: 115912.

Quantifying effectiveness of trees for landslide erosion control

We developed a landslide susceptibility model using binary logistic regression for silvopastoral landscapes, which for the first time includes spatial distribution models for individual trees of different vegetation types. Models were trained and tested using a landslide inventory consisting of 43,000 landslide scars mapped across an 843 km^2 area. Model performance was very good, with a median AUROC of 0.95 in the final model used for predictions, which equates to an accuracy of 88.7% using a cut-off of 0.5. We investigate the effect of highly skewed continuous tree variables on the maximum likelihood estimator by testing different sampling strategies aimed at reducing positive skewness. With an adequate sample size, we found that highly skewed continuous predictor variables do not result in an inflation of effect size. Using two farms in the study area, we illustrate application of the landslide susceptibility model for quantifying the reduction in shallow landslide erosion due to trees. Landslide erosion was reduced by 16.6% at Site 1 and 42.9% at Site 2 due to all existing vegetation. The effectiveness of individual trees on reducing landslide erosion was shown to be less a function of species than that of targeting highly susceptible areas with adequate plant densities. We found 80% of landslides are triggered in 12.1% and 7.3% of the area of Sites 1 (1700-ha) and 2 (462-ha), respectively, suggesting there is great potential for smarter targeting of erosion mitigation. The high-resolution spatial information provided by the landslide susceptibility maps can be used by decision makers in land management to support the development and targeting of erosion mitigation measures.

Spiekermann RI, Smith HG, McColl S, Burkitt L, Fuller IC 2022. Quantifying effectiveness of trees for landslide erosion control. Geomorphology 396: 107993.

Caragana korshinskii Kom. plantation reduced soil aggregate stability and aggregate-associated organic carbon on desert steppe

Background
After implementing of the “Grain-for-Green” project, *Caragana korshinskii* Kom. has been widely planted in China’s arid regions. Although natural restoration grassland and artificial *Caragana* plantations measures have long been focuses in carbon research, the combined influence of natural restoration grassland and artificial *Caragana* plantation measures on aggregate stability and the aggregate-associated organic carbon (OC) remains unclear.
Method
We selected natural grassland (NG) and three different densities of *Caragana* plantations (high planting density, HG; middle planting density, MD; low planting density, LD) on desert steppe. The soil aggregate distribution and stability index such as fractal dimension (D), mean weight diameter (MWD), geometric mean diameter (GMD), percentage of aggregation destruction (PAD), as well as aggregate-associated OC concentration and stock were measured.
Results

Results shows that the soil aggregates were primarily macroaggregates (>2 mm) and mesoaggregates (0.25–2 mm) under dry sieving while microaggregates (<0.25 mm) were preponderant under wet sieving (more than 57%). Overall, compared with *Caragana* plantations, the MWD (4.43 and 4.51 mm) and GMD (1.72 and 1.83 mm) were both highest in two soil layers under the NG and the D (2.77 and 2.71) was lowest. Compared with the NG, the aggregate-associated OC stocks in the 0-40 cm depths in the LD, MD, and HD decreased by 41.54%, 46.93%, and 42.03%, respectively. SOC stock was mainly concentrated in the soil aggregate with sizes of >2 mm and <0.25 mm. These results suggested that natural grassland restoration measures could improve the soil aggregate stability and aggregate-associated OC concentration better than *Caragana* plantation restoration measures, which NG may be optimal for increasing carbon sequestration and stabilizing soil aggregates on desert steppe.

Lu Q, Ma H, Zhou Y, Calvelo-Pereira R, Shen Y, 2022. *Caragana korshinskii* Kom. plantation reduced soil aggregate stability and aggregate-associated organic carbon on desert steppe. PeerJ 10, e12507 https://doi.org/10.7717/peerj.12507

Global tephra studies: role and importance of the international tephra research group 'Commission on Tephrochronology' in its first 60 years

Tephrochronology is a correlational and age-equivalent dating method whereby practitioners characterize, map, and date tephra (or volcanic ash) layers and use them stratigraphically as connecting and dating tools in the geosciences (including volcanology) and in studies of past environments and archaeology. Modern tephra studies *per se* began around 100 years ago (in the 1920s) but the first collective of tephrochronologists with a common purpose and nascent global outlook was not formed until 7 September, 1961, in Warsaw, Poland. On that date, the inaugural 'Commission on Tephrochronology' (COT) was ratified under the aegis of the International Union for Quaternary Research (INQUA). COT's formation is attributable largely to the leadership of Kunio Kobayashi of Japan, the commission's president for its first 12 years. We were motivated to record and evaluate COT's role and importance because tephrochronology continues to grow globally and its heritage needs to be understood, appreciated, and preserved. In addition, studies on cryptotephras, which are fine-grained glass-shard and/or crystal concentrations preserved in sediments or soils but insufficiently numerous to be visible as a layer to the naked eye, have also expanded dramatically in recent times. In this article, we therefore review the role and impacts of COT under the umbrella of INQUA for 53 of the last 60 years, or under IAVCEI (International Association of Volcanology and Chemistry of the Earth's Interior) for seven of the last 60 years, including since 2019. The commission also functioned under other names (abbreviated as COTS, CEV, ICCT, COTAV, SCOTAV, and INTAV; see Table 2 in text for definitions). As well as identifying key persons of influence, we describe the development of the commission, its leaders, and its activities that include organising nine specialist tephra-field meetings in seven different countries. Members of the commission have participated in numerous other conferences (including specialist tephra sessions) or workshops of regional to international scale, and played leading roles in international projects such as INTIMATE (INTegrating Ice-core, MArine and TErrestrial records)

and SMART (Synchronising Marine And ice-core Records using Tephrochronology). As well as strongly supporting early-career researchers including graduate students, the commission has generated ten tephra-themed journal volumes and two books. It has published numerous other articles including field guidebooks, reports, and specialist internet documents/sites. Although its fortunes have ebbed as well as flowed, the commission began to prosper after 1987 when key changes in leadership occurred. COT has blossomed further, especially in the past decade or so as an entire new cohort of specialists, including many engaged in cryptotephra studies, has emerged alongside new geoanalytical and dating techniques or protocols to become a vibrant global group today. We name 29 elected officers involved with COT since 1961 and their roles, and 15 honorary life members. After reviewing the aims of the commission, we conclude by evaluating its legacies and by documenting current and future work.

Lowe, D.J., Abbott, P.M., Suzkui, T., Jensen, B.J.L. 2022. Global tephra studies: role and importance of the international tephra research group 'Commission on Tephrochronology' in its first 60 years. *History of Geo- and Space Sciences* 13, 93-132. https://doi.org/10.5194/hgss-13-93-2022 (open access)

Reducing nutrient and sediment losses in surface runoff by selecting cattle supplement feeding areas based on soil type in New Zealand hill country.

Nutrient loss in surface runoff from hill country catchments is typically generated from small areas and over short time periods. This study compared nutrient and sediment losses in surface runoff when cattle were fed winter hay supplement on two hill country sub-catchments (~0.3 ha) with contrasting soil types (imperfectly-drained and well-drained soils). Runoff samples were collected during seven events (June-August). During this period, two herds of 16 pregnant, mixed aged Angus cows were supplemented with 2 kg DM. cow day^{-1} of hay in a defined feeding area within each sub-catchment. The imperfectly-drained soil measured 4.8 times the volume of surface runoff compared to the well-drained soil. As a result, the imperfectly-drained soil lost 2.5 times the amount of sediment, 6.3 and 5.1 times the amount of total phosphorus (TP) and dissolved reactive phosphorus respectively and 4.5 times the amount of total nitrogen (TN). Surface runoff losses of nitrate-N from the well-drained soil were undetectable over the study period. Whilst overall nutrient losses were low over the short study period (0.22 kg TP ha^{-1} and 0.68 kg TN ha^{-1}), the results highlight the potential benefit of strategically placing cattle feed supplements on soils less prone to surface runoff to improve freshwater outcomes.

Fransen P, Burkitt L, Chibuike G, Bretherton M, Hickson R, Morris S, Hedley C, Roudier P 2022. Reducing nutrient and sediment losses in surface runoff by selecting cattle supplement feeding areas based on soil type in New Zealand hill country. New Zealand Journal of Agricultural Research: 1-18. On-line early.

Obituary - Dr Ronald Bruce Miller

Dr Ronald Bruce Miller: O.B.E.

Soil Scientist; born October 19, 1922; died January 29, 2022

Bruce Miller was never the boring scientist of popular stereotype and is remembered as a man who believed in making science accessible to all. A soil scientist who made his mark internationally, Miller died in Waikanae, in January, aged 99.

A lifetime fan of Monty Python, he loved a joke and one of his favourite sayings was “never treat soil like dirt”.

Born in Kaikōura, Bruce was the son of Ronald Miller, a Presbyterian minister and Jessie Miller (née McGregor).

Educated at Manaia District School in South Taranaki and then Palmerston North Boys’ High School, he made the first XV and became dux in his final year at Boys’ High. Then, following in his father’s footsteps, he studied at the University of Otago and Knox College, graduating with a MSc in 1945. He completed his PhD at the Royal Agricultural College in Sweden. In those days, studying overseas was a major undertaking and to get to Sweden he worked his way over on a ship, assisting the cook.

Miller had a distinguished career as a scientist and science administrator. It was as a scientist at Soil Bureau in Lower Hutt where he would make his mark, serving as Director and later as Chief Director at DSIR. Created in 1936, Soil Bureau had a broad agenda, but its core role was researching and studying soil for the benefit of agriculture, forestry, and engineering. One of his long-term projects was studying nutrients in soil at the nearby Keith George Memorial Park in Upper Hutt.

As a scientist Bruce held the view that science has an important role in the wider world, and he completed a philosophy degree to expand his knowledge beyond science. He always made an effort to involve the public and measure public reaction to scientific endeavours and progress, even involving himself in a pioneering programme to encourage secondary school pupils to take science subjects.

Miller quickly realised the importance of research and sharing ideas both nationally and internationally. From 1968 to 1969, he was an André Meyer Fellow at the United Nations' Food and Agriculture Organisation in Rome. During his time in Rome, he helped prepare a soil map of the world, showing the distribution of soil types which, for the first time, gave a measurement of the world's soil resources.

With the sudden death of Soil Bureau Director Maurice Fieldes in 1973, Miller was chosen from a strong field to replace him, and he quickly made his mark in the role. He pioneered the consideration of soil as part of a wider ecosystem and looked into climate, vegetation and the impacts of human activity on beech forest systems. At the time it was a world-leading approach.

In 1980, he exhibited his world view knowledge by leading a delegation of New Zealand scientists to China as it looked to recover from the purge of scientists after the Cultural Revolution. He felt China had significant potential in agricultural science and it was important for New Zealand to tap into that potential. The following year he invited Chinese scientists to come to New Zealand, forming a lasting relationship with the emerging scientific power.

Former colleagues remember Miller as a man dedicated to science and as a leader who encouraged his staff to be ambitious. Former colleague Craig Ross describes him as a "people person" who actively engaged with staff. *"He was the only 'big boss' I ever had in my 43-year career who occasionally would come down into our soil physics lab, plonk himself down on a chair beside me, and have a brief chat about what I was doing and how things were going."*

Another former colleague, Les Molloy, says that as Director, Miller left his mark. *"He was very encouraging and never aloof. He would have lunch with us and we had some very wide-ranging discussions. He was very well-read and he knew a lot about world affairs."*

Miller was involved in many professional societies including International Society of Soil Science, Royal Society of NZ, the Stout Trust and NZ Ecological Society. With Dr Norman Hargrave Taylor, Miller was involved with the founding of the NZ Society of Soil Science where he served on the Council from 1953 to 1974 and was president from 1966-68. In 1962 he was secretary-general of the International Soil Conference held in Palmerston North.

Miller was awarded an OBE in 1984 and a Sesquicentennial Medal in 1990 for his contributions to science. His list of publications included journal papers, bulletins and maps, with a specific interest in soil chemistry and a wider interest in soil surveys, soil fertility in pastures and nutrients in forest ecosystems.

After he retired, Miller remained involved in science, travelling to Manila to help set up an international research and development fund. He was also involved with FORST

and science funding grants and the Ministry of Research, Science and Technology which did pioneering work assessing the value of science in supporting land management in New Zealand.

In retirement, he continued to follow rugby - one of the great joys of his life. One of his fondest memories was seeing the 1937 Springboks training.

He met Rae McLaughlin (BSc Victoria) librarian, at Soil Bureau. They married in 1955 and had four children: Robyn Weston, Fiona Carter, Andrew and Alistair Miller. Rae Miller died in June 2022, aged 95.

Deadline..... for the November 2022 issue of Soil News is Friday 11 November.

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