

SOIL CRC

Performance through collaboration



YEAR IN REVIEW

2025

Major Partners



Partners



Associates



Contents

About the Soil CRC	2
Message from the Chair and Chief Executive Officer	4
Highlights and achievements	6
Program 1	8
Program 2	10
Case study 1: Measuring soil microbes	12
Program 3	14
Program 4	16
Case study 2: New farming methods to sequester soil carbon	18
Research project updates	20
PhD student program	46
Our PhD students	52
Our people	56
Financial summary	60
Our publications	70

2025 in Review

4

NEW
PROJECTS
APPROVED



17

PROJECTS
COMPLETED



1

NEW PHD
STUDENT
COMMENCED



32

PHD STUDENTS
CURRENTLY STUDYING



\$445,000

COMMITTED TO
NEW PROJECTS



24

ACTIVE
SOIL CRC
PROJECTS



About the Soil CRC

The Cooperative Research Centre for High Performance Soils (the Soil CRC) was established in 2017 to give farmers the knowledge and tools they need to make decisions on extremely complex soil management issues.

Through our soil research and innovation program, we are developing new solutions that are unlocking the potential of Australia's agriculture sector.

Our practical, real-world outputs allow farmers to optimise their productivity, yield and profitability, and ensure the long-term sustainability of their farming businesses.

The Soil CRC is the largest collaborative soil research effort in Australia's history, bringing together 8 universities, 4 state government agencies, 7 industry partners and 20 farmer groups.

Our multi-disciplinary research efforts are helping Australian agriculture to reach its target for farm gate output of \$100 billion per year by 2030.

Vision

Australian farmers using best practice soil management to underpin a dynamic, sustainable and profitable agriculture sector.

Mission

To contribute new knowledge, tools and practices to help Australia's farmers better manage their soils in order to improve the profitability, sustainability, resilience and wellbeing of the agriculture sector.



Values

Collaborative

The Soil CRC is a collaborative and inclusive research and adoption organisation, passionate about soil, and bold in its approach to delivering outcomes.

End user-driven and focused

The Soil CRC is end user-driven in all things it does. Through farmers and other groups, industry are genuine partners in the CRC, helping to set priorities, develop proposals, undertake research, interpret results and communicate new knowledge.

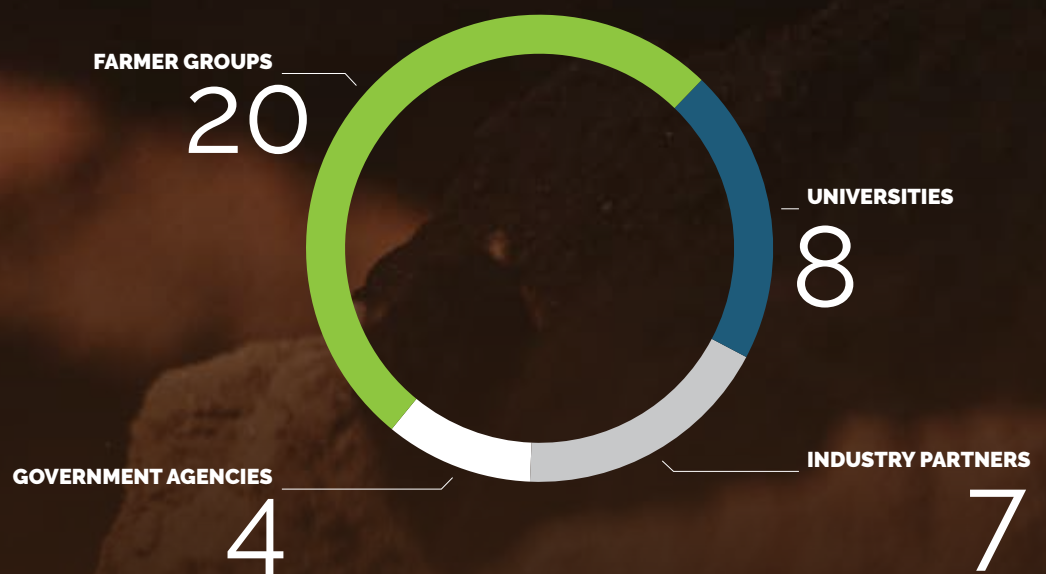
Multidisciplinary

The Soil CRC employs the necessary disciplines and expertise to deliver change during the life of the CRC, while being aspirational in its long-term goals to ensure a continuing legacy.

Research excellence

The Soil CRC is committed to research excellence in science practice, capacity building, governance, management, integrity and ethics. The CRC is committed to being a national collaborative leader, recognised as an integral part of Australia's agricultural innovation system.

Participants



Message from the Chair and Chief Executive Officer



The Soil CRC is recognised as Australia's leading collaborative soil research effort, bringing farmers, industry and research together to deliver practical solutions for our underperforming soils. With 8 years of research and extension activity now complete, we are increasingly focused on the legacy we will leave when our 10-year funded term comes to an end in June 2027.

Our Adoption Plan was finalised in 2024 and now guides our integration, adoption and outreach activities. An implementation plan was developed with our grower group partners to ensure that the knowledge outputs of the Soil CRC are appropriately disseminated to next users, and ultimately to the farmers and land managers who are dependent on high performance soils. We continue to work closely with these groups and other delivery partners, including the Regional Soil Coordinators, to ensure our research outputs are accessible and applied where they have the greatest impact.

To date, the Soil CRC has completed 57 projects, with 17 completed this financial year. The last of our research budget allocations were made in 2025, with 4 new research projects receiving a cash investment of \$445,000 and a further \$610,000 of



in-kind contributions from participants and \$117,000 from third parties. Two of these projects build on the Soil CRC's flagship rural landholder social benchmarking study, demonstrating the value of our landholder surveys to the Australian agriculture industry. The other 2 projects focus on knowledge sharing and evaluating the Soil CRC's research impact.

This investment brings the total spending on projects to more than \$41 million since the CRC commenced in 2017. This has been supplemented by a number of externally funded projects, providing over \$10 million in additional funding to date.

An example of this additional funding is the funding provided to us in 2024 from the NSW Department of Climate Change, Energy, the Environment and Water through the Primary Industries Productivity and Abatement Program to provide information to NSW land managers about soil carbon management. We have since worked with our participants to deliver 7 webinars and supporting fact sheets to help farmers make evidence-based decisions to support carbon farming.

The work of the Soil CRC continues to contribute to the 3 goals of the National Soil Strategy: prioritise soil health, empower soil innovation and soil stewards, and strengthen soil knowledge and capability. Our research and extension activities support the National Soil Action Plan, which outlines priority actions to improve Australia's soil health and long-term security.

Our PhD students represent a wide range of disciplines and are a key part of the contribution that the Soil CRC is making to Australia's future



capacity in soil research. In 2024–25, 8 of our students completed their PhDs, bringing the total number of completions to 15. With 6 students having submitted their theses for examination and all PhD positions now filled, the Soil CRC is well on the way to reaching its target of 40 PhD completions. Importantly, most of our completed students are now employed in soil research-related and other roles within agriculture.

Building collaborative networks remains a priority for the Soil CRC Board, staff, students and participants, and we have engaged in many face-to-face meetings and workshops throughout the year. More than 150 delegates attended our 2024 Soil CRC Participants Conference in Wagga Wagga, NSW, to hear about our work, see soil research in action, and to network and collaborate.

We were also a Lead Supporter of the Parliamentary Friends of Soil (PFOS) World Soil Day breakfast event at Canberra's Parliament House, which shined a spotlight on the importance of healthy soil. Soil CRC PhD student Dr Reuben Mah expertly delivered a presentation on his research, titled 'Lab on a chip: combining precision and convenience in soil monitoring'. Other speakers included PFOS Co-Chairs the Hon Michael McCormack MP and Meryl Swanson MP.

We acknowledge the Soil CRC Board, management and staff for their ongoing contribution to the organisation's operation, and extend our gratitude to all Soil CRC participants, researchers and students who are collaborating to deliver the outcomes of the Soil CRC. It is these productive and collaborative partnerships, formed through the Soil CRC, that will perhaps be our most enduring impact.

In early 2025, we farewelled Associate Professor Richard Doyle from the Program Leadership role as he retired from his position at the University of Tasmania. Richard was a Program Leader from the commencement of the Soil CRC and helped to shape the research program and its delivery, especially in Program 2, Soil Performance Metrics. He has been replaced by Dr Nathan Robinson from Federation University Australia who has already shown his leadership in this area.

At a Board level, we said goodbye to retiring Director Kate Lorimer-Ward and welcomed Dr Peter Carberry, Dr Nathan Craig and Professor Helen Thompson.

While we considered options to create a post-Soil CRC entity to take over from the current CRC when it concludes, the Soil CRC Board resolved not to proceed with these options and instead to focus on our legacy and extension efforts, ensuring our research products are passed on to next users in a range of ways.

We are excited to see what the Soil CRC will achieve in its final two years as we work to extend our knowledge outputs to those who serve to benefit from them, and focus on leaving a legacy that will be felt by the Australian soil research and agricultural industries well into the future.

Dr Paul Greenfield AO FTSE, Chair, Soil CRC

Dr Michael Crawford, CEO, Soil CRC

The story so far



Over \$41 million cash committed to projects



Over \$10 million additional investments



57 projects completed



51 Commonwealth milestones achieved



57 PhD student commencements



15 PhD student completions



7 registered trade marks

Highlights and achievements

- **We approved funding for 4 new research projects** with a cash investment of \$445,000 and a further \$610,000 of in-kind contributions from participants and \$117,000 from third parties.
- **We welcomed a new PhD student in 2024–25 and saw 8 students complete their PhD**, taking the total number of active students to 32 and the total number of completions to 15.
- **We lodged a patent application for aspects of our 'Lab on a Chip' device.** This provides legal protection for the invention and accelerates innovation.
- **We listed the BANDICOOT® smart penetrometer and QUOLL® eNose sensor on the AgriFutures growAG website** to attract investors and raise the profile of our devices. A potential commercial partner for the BANDICOOT® has been identified and discussions are underway.

- **More than 150 Soil CRC participants and stakeholders gathered in Wagga Wagga, NSW, for our 2024 Soil CRC Participants Conference.** The conference highlighted our latest research and provided an opportunity for delegates to network and collaborate.
- **We worked with our participants to deliver 7 webinars and supporting fact sheets to help NSW farmers** make evidence-based decisions to support carbon farming. These resources were jointly funded by the NSW Department of Climate Change, Energy, the Environment and Water through the Primary Industries Productivity and Abatement Program.
- **Our researchers and students published 22 journal articles and more than 30 conference papers about Soil CRC research.**
- **We were a Lead Supporter of the Parliamentary Friends of Soil World Soil Day event** at Canberra's Parliament House. Soil CRC PhD student Dr Reuben Mah presented his award-winning presentation, 'Lab on a chip: combining precision and convenience in soil monitoring'.
- **Our CEO Dr Michael Crawford showcased the work of the Soil CRC to a national and international audience,** speaking at the APEC Forum meeting on food security in Peru, the University of Western Australia Institute of Agriculture's Industry Forum in Perth, the joint New Zealand Society of Soil Science (NZSSS) and Soil Science Australia Conference in Rotorua, the Australian Soil Information Symposium in Canberra, the Talkin' Soil Health Conference in York (WA), the Grain Sustainability Forum in Sydney, and the Collaborate Innovate conference in Melbourne.
- **We continued to support implementation of the National Soil Strategy** with contributions to steering and working groups, and to research which supports its 3 goals: prioritise soil health, empower soil innovation and stewards, and strengthen soil knowledge and capability.
- **We commenced the Future Drought Fund Long Term Trials project** working with 11 partners to establish and maintain long term experiments at 7 sites in 3 states, looking at how soil management might improve drought resilience.



Program 1

Investing in high performance soils

Program Leader: Professor Catherine Allan, Charles Sturt University

Research activities in Program 1 are focused on social and economic aspects of soil stewardship. Useful and productive collaborations among university-based researchers and practitioners from farmer and industry groups continued to build over the past year.



Program 1 participants are developing an extensive 'public good package' of information and capacity-building activities for researchers, farmer groups and Soil CRC partners. The 3 related outputs in the package will support and enable opportunities to accelerate change and build adaptive capacity in soil stewardship.

The first output involves using markets to reward farmers for improved soil stewardship. In 2024–25,

our research highlighted the inadequacies of existing reporting standards in relation to good soil management. This work included documenting soil and critiquing reporting practices of ASX-listed agricultural, food and beverage companies between 2003 and 2024, along with preliminary suggestions for improvement. Consumer markets were also considered, with the development of potential models for ensuring the veracity and value of soil management practices. A start has also been made on pulling together the various strands of financial, property and consumer market research undertaken in Program 1 since 2018.

The second output relates to acceptance and use of approaches to soil stewardship among farmers. Two of the second round of social benchmarking surveys were completed in 2024–25, and another 2 initiated. Tools to support farmers and their advisors



were also developed in the past year. In one project, completed in 2024–25, a framework and tool to assist in assessing the economic feasibility and benefits of high-grade organic fertiliser from waste was developed. In a separate research project, led by a farmer group, a tool aimed mainly at advisors was completed, which will aid assessment of the risks and rewards of new farming practices and technologies. In another farmer-group-led project, improved extension practices were developed. Approaches for multi-criteria analyses of farming practice also continued to be explored.

The third output relates to innovative and effective ways of operating and collaborating in complex and uncertain situations. In 2024–25, a catalogue of all Soil CRC projects was developed, with individual group extension plans related to some of those projects documented. The aim is to ensure the great

outputs across the Soil CRC programs are taken up and shared as effectively as possible.

The 2 remaining PhD studies related to this program continue to add to knowledge and expertise in outputs 1 and 2. In 2024–25, various streams of activity, building on the outputs from previous projects, and complemented by PhD research, were drawn together. This was possible because of the strong networks developed among all participants in this program.

Consolidation of the information in portfolios that are accessible and relevant will continue in the remaining 2 years of the Soil CRC. The learnings from Program 1 activities have informed the development of the Soil CRC Adoption Plan and will now guide its implementation.

Program 2

Soil performance metrics

Program Leader: Dr Nathan Robinson, Federation University Australia

Program 2 is focused on understanding and developing indicators of soil performance, aiming to improve soil productivity, sustainability and profitability. The program involves 20 grower groups, 7 universities, 4 government research partners, and 12 PhD students working on tools and information that help farmers enhance soil management.

Over the past 8 years, projects have explored the development of tailored soil indicators that are useful to both farmers and advisors. While chemical tests and visual crop and soil assessments are commonly used, biological indicators remain less understood. To address this, research nearing completion has found that total soil organic carbon and autoclaved-citrate extractable (ACE) protein are key biological contributors to soil structure. This foundational work will support more accessible and relevant interpretations of biological indicators and their interrelationships for farming systems across southern Australia in 2025–26.

Significant progress has also been made in sensor technology. Devices such as the BILBY® underground communication node have undergone rigorous field testing and are now commercially ready. Similarly, the BANDICOOT® smart penetrometer has been redesigned to better measure indicators such as salinity, waterlogging, compaction and water deficit. It is scheduled for rollout in 2026, with grower groups leading long-term drought resistance trials using this tool.

The QUOLL® soil electronic nose continues to attract strong interest from researchers and industry for use in trials and demonstrations in 2025–26. Technological improvements to the Lab on a Chip (LOC) – a 3D-printed microfluidic device for rapid in-field measurement of soil chemical properties – have enhanced its performance under diverse environmental conditions. This includes better measurements of enzymes (phosphatase,

β-glucosidase and sulfatase) and soil nitrate. Future research will explore using the LOC for plant sap nitrogen analysis.

On the data analytics front, Program 2 is advancing soil water dynamics modelling, machine learning and sensor data fusion. One key focus is automated prediction of soil water retention values, such as wilting point and field capacity, using machine learning to potentially calibrate moisture probes across Australia. Research using radar data and remote sensing has enabled forecasting of in-paddock variability of plant-available water, extending this capability across the country's radar zones.



The third phase of the Visualising Australasia's Soils (VAS) project has begun, aiming to establish a lasting digital platform for the Soil CRC and its stakeholders. The VAS portal is being migrated to the Laravel framework to increase application flexibility, efficiency and cybersecurity, while enhancing user experience.

All this research is geared toward delivering mobile tools to help farmers address soil constraints. For example, the LOC smart application is nearly complete. Another project involves a smartphone app that uses machine learning (neural networks and random forests) to train hybrid models for predicting Munsell soil colour (used for soil classification and identification).

Program 2 currently supports 9 PhD students in various stages of their research, with 2 more recently submitting their theses. Their work spans biological indicators, sensor technology, machine learning, soil moisture monitoring, and data integration using proximal and remote sensing.

A key goal of Program 2 is ensuring these innovations are practical and readily adopted by farmers and advisors. By connecting research outcomes directly to end users in agriculture, the program aims to improve soil decision-making on the ground and ensure long-term impact across Australian farming systems.





Farmers and scientists increasingly recognise that soil biology underpins both productive farming systems and healthy ecosystems. Many landholders are keen to measure soil biology to understand how their management affects the soil, and to guide decisions such as reducing chemical inputs or building soil carbon. Yet choosing what to measure is not straightforward.



Case study 1

Measuring soil microbes

A wide range of soil tests can assess the diversity, abundance and function of soil microbes, but most are difficult to interpret or apply. Some are too broad to guide action, others too narrow to be widely useful, and many vary over time in ways that make them unreliable for on-farm monitoring.

The Soil CRC's 'Measuring soil microbes' project (2.1.008) set out to evaluate how different management practices influence soil biology and how those measures relate to soil function and crop health. The goal was to identify tests that are both practical and cost-effective, and that could eventually form part of routine soil health monitoring on farms.

Large-scale sampling across regions and seasons

The study ran across 5 sites in Australia, managed in collaboration with Wheatbelt NRM (WA), Central West Farming Systems (NSW), Birchip Cropping Group (Vic), the South Australian Research and Development Institute, and the Northern Grower Alliance (NSW).

Over the 2022 and 2023 growing seasons, more than 400 soil samples were collected at 6 stages from pre-sowing through to post-harvest. Researchers measured 89 different soil properties, from pH and carbon fractions to microbial biomass, nematode populations and soil respiration.

"No single measure captures the complexity of soil biology. By testing a suite of soil properties across sites and seasons, we can start to see which ones are sensitive to management changes and which are more stable over time," said Dr Mick Rose, Soil CRC Project Leader and Associate Professor at Southern Cross University.



Most of the tests used have well-established methods. This project validated and refined several specialised microbial tests, including:

- phospholipid fatty acid (PLFA) analysis to measure fungi and bacteria and track changes in their balance under different conditions
- soil enzyme assays to show how actively microbes cycle carbon, nitrogen, phosphorus and sulphur
- quantitative PCR (qPCR), a DNA-based method used in research to count total fungi and bacteria with high precision.

Promising soil biology tests

Among the wide range of measures assessed, several showed promise for future soil health monitoring. Soil protein emerged as a strong candidate. It is relatively low-cost and closely reflects soil biological activity. International research has also shown clear links between soil protein and critical functions such as nutrient supply and soil structure, reinforcing its potential for routine use in soil testing.

Labile carbon, the fraction of carbon most readily available to microbes, was also strongly associated with healthier and more diverse microbial communities. Building this form of carbon supports greater microbial activity and diversity, which in turn contributes to soils that are more resilient and biologically active.

Nematodes provided a useful signal of broader system differences, distinguishing between regenerative and conventional farming practices. They were also responsive to pesticide use, particularly fungicides, highlighting their sensitivity to management changes.

DNA-based tests proved the most sensitive overall, detecting changes from practices such as liming, crop rotation and pesticide use. However, while powerful, these methods are expensive and are not yet practical for routine use on farms.

Next steps

The next phase of the project will focus on making soil biology tests more accessible and useful for landholders. Practical guidance will be developed to help farmers interpret results and understand how their management practices are shaping soil biology.

“We want to move soil biology testing out of the research space and into everyday use. That means giving farmers clear guidance on how to interpret results,” said Dr Rose.

The project will also work to integrate microbial indicators into national and industry programs, allowing initiatives such as the national soil monitoring program and Grains and Research Development Corporation (GRDC) projects on soil health frameworks and regenerative agriculture to benchmark and compare results more effectively. A further priority is to encourage commercial laboratories to adopt the most promising indicators, with particular emphasis on measuring free-living nematodes and soil protein.



Program 3

New products for soil fertility and function

Program Leader: Professor Megharaj Mallavarapu, University of Newcastle

Program 3 aims to develop new fertiliser formulations, pesticide delivery systems, soil enhancements, microbial carrier products and improved mechanisms for delivering these solutions to farmers. These pursuits collectively aim to enhance soil performance and productivity for farmers.

This program brings together 10 grower groups, 7 universities and 15 industry partners. There are 12 active projects and 8 completed projects, with 10 current PhD students and 7 PhD completions.

Significant achievements include the synthesis of micro-lime, micro-gypsum, novel biochars/ biochar-clay composites (phosphorus- and zinc-loaded) as slow-release fertilisers, demonstration of the value of manures as phosphorus fertilisers, development and field demonstration of microbial carriers and high moisture retention products.

Key achievements in 2024–25

Biochar-clay innovations

- Novel surface-engineered biochar-clay nanocomposites were developed as fertilisers to address nutrient stratification in soil.
- Agricultural and food waste (winery, coffee and canola residues) were utilised as biomass feedstocks for sustainable biochar production.
- Slow-release nutrient composites were synthesised by integrating biochar with clays such as halloysites, attapulgite and amino clays, and enriched with phosphorus and zinc.
- A coffee waste-amino clay composite was identified as the most promising formulation and is currently under glasshouse trials.
- Glasshouse experiments commenced, showing potential as potent phosphorus fertilisers for agricultural crops.
- Bulk production of other composites, including those from canola waste, is planned for future trials.



Plant growth and manure studies

- All field trials were successfully conducted across 3 consecutive seasons on low-phosphorus soils at Tallimba, NSW, using wheat as the crop, and comparing superphosphate and chicken manure.
- A positive trend in phosphorus uptake at the anthesis stage was observed in plots treated with manure.
- At maturity, neither phosphorus source nor application rate had a significant effect on grain yield, indicating no effect on yield for replacing superphosphate with organic manure.
- Despite similar yield outcomes, the intermediate boost in phosphorus uptake with manure suggests organic amendments may enhance early nutrient dynamics, supporting more sustainable fertiliser strategies.

Enhancing Phosphorus efficiency with organic amendments

- Earthworm liquid and pyroligneous acid was found to significantly enhance phosphorus use efficiency by interacting with soil minerals and improving soil chemistry.

Biosolids-derived biochar for improving soil fertility

- With additional funding from 6 water authorities across Australia, and in collaboration with Southern Farming Systems and the University of Newcastle, field trials were initiated in Victoria using biochar from South East Water biosolids in wheat cultivation to understand the impact on soil.

Organic-based nitrogen fertilisers

- Three novel organic nitrogen fertiliser products were successfully manufactured.
- Multi-location field trials were established in Burdekin (Qld), Condobolin (NSW) and Birchip (Vic).
- Glasshouse experiments are underway to evaluate the nitrogen use efficiency, soil health and crop productivity of the novel fertiliser products.

Moisture retention products

- A suite of locally sourced eco-friendly high moisture retaining organic-based and clay-based materials were successfully developed.
- These materials demonstrated positive effects on wheat growth, indicating high scalability and potential for commercialisation.

Microbial carrier products

- Four superior microbial carrier formulations were developed.
- These formulations outperformed traditional peat-based formulations by demonstrating high rhizobial survival, enhanced nodulation and improved drought tolerance.
- A successful soybean glasshouse trial was conducted using soils from Queensland, South Australia and New South Wales under 2 water regimes (55% and 30% water holding capacity).
- Field trials are underway across New South Wales, South Australia, Western Australia and Queensland.
- These formulations show strong commercial potential.

Program 4

Integrated soil management solutions

Program Leader: Dr Lukas Van Zwieten, NSW Department of Primary Industries and Regional Development

Program 4 aims to develop cost-effective and sustainable soil management solutions to build more productive and resilient soil. This will underpin a dynamic, sustainable and profitable Australian agriculture sector.

Projects in Program 4 continue to oversee an extensive network of more than 11 field sites, strategically located with grower groups and research organisations to address multiple key soil constraints across various regions. In 2024–25, the program directly engaged 13 grower groups in its activities. These collaborations have fostered strong and sustained partnerships between researchers and grower groups, positioning them to extend beyond the life of the Soil CRC.

The program has 3 key outputs that are collectively delivering innovative soil management techniques, products, data and models that can be used by farmers to better manage their soils. Our research is transitioning from proof-of-concept to delivery across all 3 outputs.

Output 1: Novel plant and systems-based solutions to improve soils

Cover cropping, mixed-species cropping, intercropping and regenerative agriculture practices have been evaluated in the Australian context. Field sites in New South Wales, Victoria

and Western Australia are being used to ground truth the role of cover crops and assess how these systems-based methods can increase soil carbon and resilience.

Deep sandy soils across Western Australia's wheatbelt remain challenging due to their low water-holding capacity, poor nutrient retention and unreliable yields. With the completion of our 'New farming methods to sequester soil carbon' project (see case study 2), ongoing analysis at the 4 field sites in Bullaring, Kweda, Wathingarra and Coorow is delivering promising results. Plant-based solutions such as seradella as a pasture break or cover crop have raised soil carbon and available phosphorus, while vetch in crop rotations has improved soil health, particularly by increasing soil nitrogen and other biological indicators.

In another project, 2024 data from field sites at Burramine and Birchip (Vic) and Condobolin (NSW) show that, in seasons with restricted rainfall, cover crops can substantially reduce cash crop yields. The impact of cover crops on water availability at the



Burramine site is being closely examined through another project, with further recommendations to come.

Summer cover cropping has been linked to a noticeable reduction in water availability at the time of winter crop sowing and corresponding yield penalties. In contrast, temporary intercropping with vetch did not reduce wheat yields when sown concurrently in this trial. Although intercropping resulted in a small increase in biomass, to date it has had little or no effect on soil health or soil carbon levels.

A project evaluating ecosystem-based practices for improving soil resilience to drought wrapped up in 2024. Meta-analysis revealed that drought initially reduced microbial respiration and biomass, but while respiration recovered after the stress, microbial biomass remained low for longer. Field studies demonstrated that minimum tillage, cover crops, lime and Bednar ripping improved water-holding capacity, carbon distribution and the resilience of soil microbes (their ability to recover). In contrast, soil compaction and excessive tillage reduced resistance (the soil's ability to withstand change). Pot trials further confirmed that cover cropping and minimum tillage enhanced enzyme activity, nitrogen retention and plant growth during drought, whereas conventional systems showed a loss of function. These findings highlight the importance of site-specific ecosystem management for maintaining soil resilience, promoting nutrient cycling and supporting sustainable productivity.

Output 2: Novel physico-chemical-based solutions to improve soils

The program is delivering field-based data on novel physico-chemical solutions to soil constraints, with a total of 8 field sites continuing across multiple states. Variable responses to physical and chemical amendments underscore the need for this mechanistic research to better understand site-specific factors that influence treatment effectiveness. The ongoing trials will provide valuable insights into optimising these interventions for different soil types and climatic conditions.

Work is continuing to develop and demonstrate effective strategies for overcoming soil constraints that have historically limited crop productivity.

Two field sites have been established in South Australia's upper Eyre Peninsula as part of a new project that is building on previous Soil CRC research to overcome soil constraints on highly calcareous soils. This research will develop a dose response to the novel carbon-based phosphorus fertiliser previously developed, and will evaluate a range of phosphorus sources.

Six field trial sites, established under completed Soil CRC projects, were transitioned into a new project to capitalise on established field trials for ameliorating subsoil constraints. The sites are based in Western Australia on sandy soil, New South Wales on sodic clay soil and Queensland on compacted soil.



Output 3: Soil improvement decision support tools

Program 4 has delivered a suite of outcomes that advance soil-constraint management in Australian dryland cropping systems. The 'Optimising soil constraint management through computer-based learning and modelling' project was completed in 2025, bringing together data analysis, field trials and crop modelling to improve how soil constraints are managed in Australian cropping systems. It developed a knowledge-guided model for constraint-specific amelioration, ready for integration into next-generation tools. These outputs are being consolidated into DYNASOIL, an online platform that aims to convert complex science into practical, farm-ready advice. It is under development using a co-design approach and is expected to have scalable delivery. By bridging the gap between research and on-farm decision making, DYNASOIL aims to equip Australian growers with evidence-based recommendations to lift productivity and profitability while sustaining soil health.



Many Western Australian farms have sandy soils with low organic carbon, characterised by low water-holding capacity, poor nutrient retention and reduced productivity. These soils also limit opportunities to participate in carbon markets, which depend on measurable carbon gains. For grain growers across the state, improving productivity, building resilience and accessing new market opportunities can be supported by finding ways to increase soil organic carbon.



Case study 2

New farming methods to sequester soil carbon

To address this challenge, the Soil CRC partnered with the Western Australian No-Tillage Farmers Association (WANTFA), Murdoch University and grower groups including Facey Group, Corrigin Farm Improvement Group, West Midlands Group and Liebe Group. With additional funding from the Western Australian Department of Primary Industries and Regional Development, they established 4 large-scale trial sites (Bullaring, Coorow, Kweda and Wathingarra) across the WA wheatbelt to test new farming methods aimed at boosting soil fertility and sequestering carbon.

The 'New farming methods to sequester soil carbon' project (4.1.006) compared 5 approaches:

1. Traditional crop rotations
2. Crop sequencing with mixed species of pasture and crop
3. Soil amelioration including deep ripping, clay incorporation, mouldboard ploughing and rotary spading
4. Soil amendments including compost, manure, organic pellets, frass, gypsum, clay, zeolite and biochar
5. Combinations of the above.

Pathways to improving sandy soils

The sites demonstrated that there is no single solution for building carbon in WA's sandy soils. Instead, combinations of approaches will be required, adapted to soil type, rainfall and farming system.

At **Kweda**, combining compost with deep ripping showed promise for reducing subsoil constraints and improving water use efficiency, but compost alone was less effective.



The **Bullaring** trials compared legumes and legume intercropping alongside mechanical disturbance and clay incorporation. Both strategies improved soil fertility, but in different ways. Growing legumes contributed to soil carbon through plant residues, while the mechanical treatments improved nutrient retention and reduced weed competition for soil moisture.

At **Wathingarra**, rotary spading and mouldboard ploughing boosted serradella biomass. Biochar and frass applications improved nutrient uptake and showed signs of longer-term fertility benefits. Compost gave a short-term boost, but its impact declined after 3 to 4 years, and higher weed pressure was observed where compost was applied.

At **Coorow**, where cropping history was limited, clay and organic matter increased water holding capacity and early plant growth, but longer-term monitoring will be needed to confirm the effects.

Patterns across the sites

Overall, the trials showed that improvements in soil fertility were greatest when amendments were combined with physical amelioration. Water-holding capacity and nutrient retention increased, helping crops make better use of rainfall and fertiliser. The yield responses were more modest and often declined by the third year.

"On these low-fertility sands, yield is often the focus, but what stood out was how the soil itself improved. Better water-holding capacity and nutrient retention give us a foundation to build on," said Dr David Minkey, Soil CRC Project Leader and Executive Director of WANTFA.

Carbon gains were small and variable across the sites, which was expected given the short timeframe

of the project. Building soil carbon is a slow process, especially in sandy soils with low clay and organic matter. However, the combination of crop sequencing, soil amelioration and amendments showed the strongest potential for achieving long-term gains.

"This isn't a quick fix. You don't see huge jumps in carbon in these soils in just a few years. But the results show we can make these soils healthier and more productive now, and set them on a pathway to storing more carbon in the future," Dr Minkey said.

What's next

Three of the sites will continue under a new Future Drought Fund-supported Soil CRC project. This research will capture seasonal variation impacts on results and provide a stronger evidence base for how different practices affect soil health, carbon and crop performance.

Dr Minkey said the long-term perspective is essential. "We need to know not just what works in year one, but what still delivers after 5 or 8 years. That's when farmers can really weigh up the economics and decide which practices are worth investing in."



Funding acknowledgment

The project received funding from the Western Australia Department of Primary Industries and Regional Development through the Future Carbon Program, with additional funding being provided by the Soil CRC.

Research project updates



Soil stewardship certification potential

About the project

Certification that includes soil management has the potential to facilitate rewards for farmers who are engaged in using soil stewardship practices. To be successful, any new approach or modification to existing certification schemes will need to provide meaningful incentives and be acceptable to farmers and the broader agri-food value chain.

This project is investigating the potential of certification and verification schemes to help develop markets for rewarding good soil stewardship. The research findings are expected to have important implications for certification of soil in Australia, and will be of interest to other researchers, farmer groups, agri-finance organisations and the consumer food value chain.

Activities

During 2024–25 the project team:

- Conducted focus groups with farmers in northern New South Wales, southern Queensland and Victoria to understand their perspectives on the 2 draft certification schemes that were developed with stakeholders.
- Analysed and reported on the focus group data.
- Finalised the questionnaire for the consumer survey, testing several main treatments to identify what aspects of soil health matter most to consumers, use of graded labelling and increased guaranteed payments to producers, and different types of certification schemes and forms of assurance.
- Completed experimental design and programming of the online survey and commenced data collection and analysis.
- Prepared 3 journal articles to distribute the findings of the research to a wider audience.

Results and findings

The stakeholder design-thinking workshops led to the development of 2 draft certification schemes, as well as the development of a meta-governance scheme for all agricultural certification schemes to help improve their efficiency and effectiveness, and to reduce duplication across schemes.



Project 1.1.005

Project leader: Professor Mark Morrison,
Charles Sturt University

Duration: 2022–2025

Participating organisations:

- Charles Sturt University
- Southern Cross University
- University of Southern Queensland
- University of Tasmania
- Birchip Cropping Group

The focus groups sought feedback from farmers about the 2 draft certification schemes, and identified key considerations and design options to enhance acceptability for farmers. These included:

- Standards need to be flexible (not prescriptive).
- Standards need to align with current and future market opportunities.
- Farmers need a value proposition (including premiums and market access).
- Third-party auditing is required to meet the needs of the market, but is expensive and onerous.
- Farmers value options to reduce the cost of third-party auditing, including use of routinely collected data and remote technologies (drone and satellite imagery).
- Additional support options (field days, online education modules, feedback on performance indicators) are likely to be attractive to farmers – these are not commonly a feature of certification schemes.

Next steps

The input from the farmer focus groups and the findings from the consumer survey will be added to the insights from the 2 draft certification schemes. This new knowledge will enable the project team to propose design features of an optimal certification scheme that includes effective incentives for farmers to improve and/or maintain soil health.

The final step will be to report on the recommended certification or verification solution and to conduct project extension activities.

Social benchmarking rural landholders across Australia

About the project

Farmers and their on-farm management strategies are critical to the ongoing health of Australia's soils, economy and environment. The Soil CRC's social benchmarking study is a national effort to deliver landholder surveys across 6 major farming regions to better understand landholder needs.

Project 1.2.007 is delivering follow-up surveys of land managers in North Central Victoria, on the Eyre Peninsula in South Australia and in the West Australian Wheatbelt. Project 1.2.009 will complete the follow-up surveys in Central West NSW, Tasmania and the Victorian Wimmera region. So far, more than 4,000 landholders have participated in this study. Project 1.2.010 extends the Western Australia survey through the central WA Wheatbelt and into the high rainfall catchments of South West WA.

This longitudinal research will lead to increased farmer engagement and support, with the aim of improving soil management, farming productivity and ultimately, farming system resilience across Australia.

Activities

- The follow-up North Central Victoria and Eyre Peninsula surveys were distributed in the second half of 2024.
- The data from both surveys were analysed, with survey summaries and final reports prepared for regional partners.
- The follow-up Western Australia survey was developed and distributed in mid-2025. The survey area was extended through a collaboration with Wheatbelt NRM, the Western Australia Department of Primary Industries and Regional Development and the Western Australia Department of Water and Environmental Regulation.
- Survey partners will continue to promote the survey to encourage landholder participation.
- The Central West NSW survey has been developed and preparations for its implementation are underway.



Projects 1.2.007, 1.2.009 & 1.2.010

Project leader: Dr Hanabeth Luke, Murdoch University

Duration: 2023–2027

Participating organisations:

- Murdoch University
- Charles Sturt University
- North Central Catchment Management Authority
- Agricultural Innovation and Research Eyre Peninsula
- West Midlands Group
- Wheatbelt NRM
- Liebe Group
- Central West Farming Systems
- Wimmera Catchment Management Authority
- Southern Farming Systems
- Western Australia Department of Primary Industries and Regional Development
- Western Australia Department of Water and Environmental Regulation

Results and findings

- So far, survey data on landholder values is demonstrating that value orientations are important drivers of landholder priorities, and influence how they access information.
- Passing on a healthy and sustainable farm for future generations remains a top value for farmers across all regions.
- Water security remains the main issue for landholders in the Eyre Peninsula, followed by the absence of important services and sufficient infrastructure.
- Water security is the top issue for North Central Victoria landholders, followed by rising input costs.
- The top innovations and knowledge that farmers are seeking include improved long-range weather forecasting, better mobile connectivity, and knowledge about soil biology and how to improve it.
- The survey highlights opportunities for engaging landholders by addressing gaps in knowledge and opportunities for building confidence in innovative practices.

Next steps

- Responses from the Western Australia survey will be collated and the data analysed. A 4-page summary of results will be provided to regional partners, with a more comprehensive report to follow.
 - The Central West NSW survey will be distributed in 2025–26.
 - The Tasmanian and Wimmera region surveys will be developed with local partners and delivered in 2026.
 - The research findings for projects 1.2.007, 1.2.009 and 1.2.010 will be analysed and documented in publicly available reports.
 - A new Soil CRC project (2.1.011) will develop a 'rural landholder dashboard' to help make all the social benchmarking survey data accessible and searchable.
-



Packaging Soil CRC tools to enhance extension and adoption of improved soil management practices

About the project

The Soil CRC now has a range of tools and insights that help us to better understand the economic, emotional and psychological drivers that govern farmer engagement and the adoption of innovations by industry. This project is supporting 4 grower groups to critically evaluate their current extension practices and identify which Soil CRC extension tools can be combined to improve farmer adoption.

The grower groups are designing and testing proof-of-concept extension packages that improve project delivery. The project will deliver a series of extension packages that give grower groups, advisors and extension officers a stronger range of tools to better engage the farming community and improve research extension and adoption.

Activities

- The project team completed a national situational analysis of the 4 participating farmer groups to explore how each group approaches soil extension, the tools and methods they use, and the common challenges they face.
- Each grower group selected a Soil CRC project that they are involved in and designed a targeted extension package to deliver its outcomes to their local audience.
- Development of a benefit-cost analysis tool commenced and user testing is underway.

Results and findings

- All groups involved in the analysis share a strong emphasis on practical, evidence-based delivery.
- Many groups are using digital platforms – such as social media, short videos, and WhatsApp networks – to complement traditional communication methods and reinforce key messages.



Project 1.2.008

Project leader: Simon Kruger,
West Midlands Group

Duration: 2023–2026

Participating organisations:

- West Midlands Group
- Riverine Plains
- Corrigin Farm Improvement Group
- University of Newcastle
- Agricultural Innovation and Research Eyre Peninsula
- University of Tasmania
- Murdoch University

- Grower groups reported several common structural and operational challenges including short project timelines and funding cycles, event competition and information fatigue, and on-farm labour and staff resourcing constraints.
- Despite these challenges, the farmer groups are taking up new frameworks and tools to support their extension planning.

Next steps

The extension packages will be delivered. Participating groups will reflect on their delivery, share learnings with one another, and contribute to the broader evaluation of how different extension strategies work in practice.

The project is expected to provide practical insights for how farming systems groups can continue to refine their approaches to soil-related extension in locally appropriate ways.



Defining the benefits of regenerative agriculture

About the project

The economic, environmental and social benefits of regenerative agriculture have not yet been fully defined. There is a need to better understand the interactions between the development of healthy ecosystems (such as soil health) and the production of high-quality food and fibre.

This project is developing an integrated framework that can be used to assess a wide range of economic, environmental and social impacts of agriculture, allowing comparisons among different approaches.

The result will be a relevant, practical and usable decision support framework for farmers considering transitioning to regenerative agriculture.

Activities

- Six case studies, written up by the Soils for Life team, were analysed for common themes to examine the benefits of regenerative farming and how they link to healthy soil practices. The framework was refined based on these case studies.
- To further clarify the framework, in-depth interviews were conducted with farmers practicing regenerative and modern conventional agriculture. The project team drafted a journal paper analysing the in-depth interviews.
- An online survey was conducted to test the decision support framework, specifically to assess the social, economic and environmental preferences of farmers practicing regenerative agriculture and modern conventional agriculture.
- The project team published 2 journal papers – one on the social benefits literature review and proposed theoretical framework, and another on regenerative agriculture and the adaptive capacity of farmers.

Results and findings

The project has identified common themes from the literature review, case studies and in-depth interviews on how to define regenerative agriculture.



Project 1.4.004

Project leader: Dr Christine Storer,
Charles Sturt University

Duration: 2021–2025

Participating organisations:

- Charles Sturt University
- Soils For Life
- Federation University Australia
- Harper Adams University (United Kingdom)

Regenerative agriculture has a goal of holistic system improvements in environment and people, as well as economics, so the differences to modern conventional farming can be subtle. Regenerative agriculture emphasises elimination or minimisation of synthetic chemicals and fertilisers, lower stocking rates, greater intensity of rotations, higher ground cover and greater experimentation.

A diverse range of environmental benefits of regenerative agriculture was reported, including increased biodiversity and improved health of soil, pastures, microbes, animals and livestock, as well as water infiltration, retention, reduced run-off and improved water quality. The social benefits reported were more broadly defined from learning and group activities and support systems to benefit the community, family and work/life balance. The economic benefits were mostly focused on improved production, not so much the flow-on impact on costs, income, profit or equity.

Preliminary findings show that regenerative agriculture farmers are generating more environmental and social benefits to offset reduced economic benefits. This will be analysed further to better understand how to progress from modern conventional to regenerative farming while balancing these benefits.



Next steps

The project team will test the decision-making framework using quantitative research methods. Bioeconomic stochastic simulation modelling is underway based on multiple-criteria decision analysis from survey results and consultation with farmers and advisors. Comparisons are being made between modern conventional agriculture and regenerative agriculture farmers, including alternative pathways to the adoption of regenerative agriculture, and an assessment of the impacts of risk on the comparative performance. Extension activities with farmers and advisors will be undertaken to validate the outcomes.

Research by Soil CRC PhD student Pradeep Rai at Charles Sturt University is expanding on the project findings in the longer term.

Assessing the financial impacts of using organic wastes as fertiliser

About the project

While the biophysical benefits of incorporating organic wastes as fertilisers into soils are known, the financial impacts are less well understood. This project assessed the cost effectiveness of using waste products as an organic fertiliser.

The project team worked directly with farmers in Southern NSW to investigate how they can increase productivity and farm income using organic fertilisers in comparison to inorganic fertilisers. The waste products were tested for broadacre cropping systems.

The research outcomes will help farmers understand the economics of applying organic fertilisers derived from waste, thereby leading to greater uptake and application of recycled organic materials.

Activities

- The project team identified potential organic fertilisers that are commonly used (biochar, farmyard manure and chicken manure) and assessed their impacts.
- Agriculture Production Systems Simulator (APSIM) modelling was used to estimate the impacts of these organic fertilisers on crop yields, soil health and associated co-benefits.
- The impacts were assessed for wheat, canola and chickpea cropping systems.
- Assessments were conducted on farms with 3 different soil types at Holbrook and Tamworth. As a result, farmers net incomes were estimated with and without carbon values, potentially resulting from carbon sequestration due to the use of organic fertilisers.
- Data were collected through crop yields, a survey of participating farmers and secondary information sources.

Project 1.4.006

Project leader: Dr Richard Culas,
Charles Sturt University

Duration: 2022–2025

Participating organisations:

- Charles Sturt University
- University of Southern Queensland
- Holbrook Landcare Network
- Soils For Life
- NSW Department of Primary Industries and Regional Development (contributor)

Results and findings

- The survey provided evidence that farmers are increasingly using organic fertilisers.
- The assessment showed that combining organic and inorganic (chemical) fertilisers could effectively replace the sole use of nitrogen-based mineral fertilisers.
- These blended treatments maintained crop productivity while also improving soil health.
- The results could provide scientific support for the use of organic fertilisers in some cases.
- The outcomes of this project contribute to the sustainability and profitability of Australian agriculture by reducing the cost of inorganic fertiliser use, enabling the production of more food with less environmental impact.
- The framework and tools developed from this project can help farmers and industry to assess the multiple financial and environmental benefits that the use of organic fertilisers can bring.
- The findings also help policymakers, agribusinesses and researchers in developing climate-smart agricultural practices and guiding best practices in organic soil management.

Next steps

There is potential to expand this research to include a wider range of soil types and regions across Australia and beyond, offering more comprehensive insights into the long-term benefits of biochar, chicken manure and farmyard manure. This would help further refine organic amendment strategies and support farmers in diverse environments.

Future research should focus on long-term field trials and data collection to evaluate the continued impact of organic amendments on soil health, crop yields and carbon sequestration. This will help validate the findings over extended periods and adjust recommendations based on evolving climate conditions, ensuring the strategies remain effective and adaptable.

Soil CRC Accelerator Program – Maximising adoption and engagement

About the project

Translating research outputs into tangible, practical outcomes for farmers can be challenging. This project is addressing the disconnect between research, next users and end users that often leads to innovations failing to reach the people who can benefit most. It aims to accelerate the delivery of Soil CRC innovations to farmers to increase adoption and engagement.

The grower groups involved in the project themed or packaged our research outputs and innovations to meet farmers' needs. These outputs were then filtered into 3 pathways: an incubator program for novel outputs, targeted extension for ready-to-adopt outputs, or general awareness-building campaigns.

This project is creating a new model for accelerated research translation that will help to maximise the Soil CRC's impact and provide a legacy framework for future CRCs and other soil research and extension programs to follow.

Activities

- The project team developed the accelerated adoption framework, data collection process and project filtering process.
- Process diaries were adopted to enhance monitoring and evaluation, allowing streamlined data collection and reflective learning.
- The grower groups assessed, prioritised and filtered the research outputs into the 3 pathways. Each group tailored its own approach to fit local conditions and grower preferences. Fifty-six Soil CRC outputs were summarised through the filtering process.
- The grower groups are developing extension plans by using methods developed in other Program 1 projects.



Project 1.4.007

Project leader: Bret Ryan,
Southern Farming Systems

Duration: 2024–2026

Participating organisations:

- Southern Farming Systems
- West Midlands Group
- Charles Sturt University
- Birchip Cropping Group
- Central West Farming Systems
- Burdekin Productivity Services

Results and findings

Key findings so far include:

- The filtering process provides a reliable and field-informed view of the adoption readiness of the Soil CRC's research.
- R&D success hinges on being fit-for-purpose, grounded in trusted relationships and regionally relevant framing.
- Extension works best when local facilitators frame research in familiar, trusted ways.
- Farmers are more likely to act on research that is co-delivered by people they know.
- Digital tools support awareness, but in-person conversations drive adoption.
- Process diaries have proven to be a powerful reflection tool – not just for reporting, but for learning.

Next steps

These insights are informing the next phase of work, which involves co-designing practical, resource-efficient extension packages for the most promising Soil CRC research outputs.

Soil performance indicators and their interdependencies

About the project

Land managers use a range of indicators and observations to assess soil performance and limitations to agricultural production systems. Previous Soil CRC research identified that locally relevant indicators work best for different farming systems and regions.

This project aims to produce an enduring resource on key soil indicators that can be used and adopted by advisors, growers, grower groups, researchers and government.

The research will better define critical target values for key soil performance indicators across a range of agricultural settings. It will also explore what these indicator values mean for users and the sustainable management of different soils and production systems.

The soil indicators will be linked to corrective actions and management options. Co-design with farmer groups and domain experts will ensure that the research outputs – including relevant interpretations – are fit-for-purpose and fulfill users' needs.

Activities

- The project team commenced engagement with grower group partners and domain experts, holding the first co-design workshop with West Midlands Group.
- Work began on the development of a spatial framework for implementation in the project to contextualise indicators to relevant farming systems and soils.
- A spatial footprint was developed for the project, covering an area of more than 300,000 km². This was used to review and identify existing spatial datasets for application in the project and endorsement by project partners.
- Work is underway on a database to manage implementation of soil indicators and linked spatial frameworks.
- The team engaged with owners of existing soil interpretation resources to identify options to share data and information for use in this project.
- Social research and engagement activities are building on previous research findings.



Project 2.1.009

Project leader: Dr Nathan Robinson,
Federation University Australia

Duration: 2024–2026

Participating organisations:

- Federation University Australia
- NSW Department of Primary Industries and Regional Development
- University of Newcastle
- Charles Sturt University
- Primary Industries and Regions South Australia
- Agricultural Innovation and Research Eyre Peninsula
- Central West Farming Systems
- Holbrook Landcare Network
- Southern Farming Systems
- West Midlands Group
- NSW Soil Knowledge Network

Next steps

The project team will run co-design workshops with the farmer groups to confirm and prioritise soil indicators of interest. This will also identify key land uses, management practices and farming systems to link soil indicators with corrective management options.

Domain experts in soil chemistry, physics, hydrology and biology will be adapting and defining critical thresholds for soil indicators relevant to soils and farming systems of the 5 farmer group regions.

Project partners and farmer groups will be re-engaged in follow-up workshops to review tailored interpretations and identify options to share this information through members, either as an online resource or hardcopy manual for local use.



Commercialising the BILBY® – a below ground wireless sensor node

About the project

The BILBY® is a below-ground wireless communications node that sends data from soil moisture sensors to an above-ground receiver between 100 and 1,000 metres away, depending on installation depth, soil type and terrain.

The BILBY® allows farmers to install soil moisture probes – complete with power supply and communications – entirely underground, without any wires or cables connecting to the surface, keeping it safe from damage by stock, machinery or pests.

This project increased both the technical and commercial readiness of the BILBY® with the aim of delivering a field-tested, pre-commercialisation device that is ready for commercial investment, compliance testing, marketing and manufacturing.



Project 2.2.006

Project leader: Dr Marcus Hardie,
University of Tasmania

Duration: 2023–2025

Participating organisation:

- University of Tasmania

Activities and results

- Building on results of field trials undertaken last year and feedback from the commercial and industry partners, the project team has improved the design of the device enclosure and antenna.
- Sentek – the commercial partner for the project – established an unassisted trial in Brussels sprouts to test canopy biomass on signal transmission and confirm device performance.
- Results indicated that the BILBY® units perform well at 30 cm below ground and under a small (growing) canopy.
- The device was presented at the 2024 Soil CRC Participants Conference in August 2024 and at the joint New Zealand Society of Soil Science (NZSSS) and Soil Science Australia Conference in December 2024.

Next steps

While this project has concluded, discussions are underway with Sentek for a commercial licence to develop the BILBY® for scalable adoption by Australian growers.

Visualising Australasia's Soils: Building a legacy

About the project

The Soil CRC's Visualising Australasia's Soils (VAS) project began in 2019 to provide Soil CRC participants with access to data, information and knowledge on Australian and New Zealand soils. It led to the development of a dynamic web-based portal that brings together a large array of public and private soil datasets for use by the Australian agricultural industry.

Now in its final phase, the project aims to transform the VAS portal into an enduring component of an Australian soils knowledge system that is both self-sustaining and inherently useful for research and education.

The project team will establish a governance framework, business case and clear pragmatic value propositions for end users. Artificial intelligence will be harnessed to add value to soil performance data, and enhance the reporting of soil quality, function and target values for high performance soils.

Activities

During 2024–25 the project team:

- Made substantial progress in upgrading the VAS portal web framework, providing a more robust, flexible and efficient means to add functions and applications to the system.
- Uploaded ancillary data (such as soil profile datasheets, photographs, laboratory data sheets and reports) and input soil data collected in Soil CRC projects.
- Commenced work on the governance model, including data governance and stewardship guidelines.
- Conducted social research to examine the perceptions, role and application of VAS by project partners, and published the findings in a journal paper.
- Appointed 2 students to assist in mining and mapping legacy data from Federation University research theses and reports to include (as open data) in the VAS aggregator.
- Updated all publicly available datasets on the VAS portal to include metadata for data descriptions, contact details and licensing information.



Project 2.3.003

Project leader: Associate Professor Peter Dahlhaus, Federation University Australia

Duration: 2024–2027

Participating organisations:

- Federation University Australia
- University of Newcastle
- Burdekin Productivity Services
- North Central Catchment Management Authority
- Riverine Plains
- Southern Farming Systems
- Western Australian No-Tillage Farmers Association
- West Midlands Group

- Developed a tool that draws data from the Bureau of Meteorology's Rainfields system, which provides a calibration of archival rain radar data (based on the research outcomes of Soil CRC PhD student Dr Peter Weir).

Results and findings

- In addition to the public data, contributions from the project partners now include soil data from over 5,500 sites with approximately 15,000 samples and 250,000 observations. It also includes over 800 million soil probe observations.
- The integration of the rain radar data extends the capabilities for VAS and offers new opportunities for project partners to access weather data, mapped to regions and soil types.
- The social research identified that there is broad agreement amongst project partners regarding the contribution of VAS, and anticipated expectations for soil data sharing and management using the portal. However, data custodians remain reluctant to openly share data for a number of complex reasons. Activities are underway to address these challenges.

Next steps

A Community of Practice made up of the participating grower groups will establish and agree on key use-cases. These will be developed and implemented to enhance the value of VAS outcomes for project partners and industry.

Ongoing research will assess VAS's contribution as a federated soil data knowledge system. The research will provide evidence that will inform and guide future data federations.



Unlocking soil nutrients with organic amendments

About the project

Enhancing nutrient use efficiency (NUE) in agricultural soils is essential for sustainable production, particularly in the context of declining natural resources. The use of organic wastes (e.g. composts, manures, biosolids) as soil amendments can potentially reduce the dependence on naturally available materials.

This project is studying the effect of organic amendments on nutrient release in selected soils and cropping systems under different soil management practices. It is exploring how organic amendments can unlock tightly bound soil nutrients, enhancing NUE.

The project is also establishing innovative approaches to apply organic amendments in agricultural soils and examining ways to make nutrients available for plants through moisture retention and nutrient mobilisation.

Activities

- Preliminary analysis of selected agricultural soils and organic amendments was completed.
- The project team investigated the impact of earthworm casting liquid and pyroligneous acid amendments on phosphorus availability in Australian agricultural soils.
- They also commenced an experiment on organic amendments and overlapping rhizosphere effects on soil dynamics and wheat yield. The aim is to investigate how different organic materials (food waste compost, mushroom compost, cow manure) and root interactions affect soil quality and wheat growth at different stages.

Results and findings

- The team found that both earthworm casting liquid and pyroligneous acid amendments appear to improve phosphorus availability in the selected agricultural soils (a red sandy loam, a red clay loam and a grey clay).



Project 3.1.006

Project leader: Dr Girish Choppala,
University of Newcastle

Duration: 2021–2025

Participating organisations:

- University of Newcastle
- Central West Farming Systems
- South East Water
- Primary Industries and Regions South Australia
- Australian Organics Recycling Association
- Herbert Cane Productivity Services
- Manaaki Whenua Landcare Research New Zealand (now Bioeconomy Science Institute)

- By enhancing phosphorus availability in deficient soils and reducing phosphorus losses in soils, earthworm casting liquid and pyroligneous acid amendments could provide practical strategies for sustainable nutrient management in some soils.
- Preliminary results for the organic amendments experiment showed that food waste compost had the highest nitrogen and carbon contents, and mushroom compost contained the most sulphur.

Next steps

The project team will conduct further testing on microbial biomass carbon, organic carbon fractions, elemental concentrations and plant nutrient uptake.

The final stage of research involves plant growth experiments to evaluate the effectiveness of the amendments in enhancing soil productivity.

New fertilisers to overcome nutrient stratification in soil

About the project

The use of phosphorus fertilisers in Australia is relatively inefficient, with the majority of fertilisers remaining unused by crops, and wasted. This causes accumulation and uneven distribution of nutrients near the soil surface (known as stratification), which can decrease crop yields and increase fertiliser input costs.

More effective fertiliser formulations are needed to mitigate phosphorus stratification and enable the redistribution of phosphorus to the moisture-rich subsoil zones. This project will design and evaluate biochar clay-based nanocomposite fertilisers with properties for enhanced nutrient use efficiency, crop productivity, and reduced nutrient losses to the environment.

Commercialisation of a newly developed fertiliser product will benefit major grain crop growers in Australia by minimising nutrient stratification issues in the no-till system.

Activities

- During 2024–25, significant progress was made in the development of a phosphorus- and zinc-loaded biochar-based fertiliser. Two to three different types of biomass sources were used.
- The dual-release fertiliser that contains both phosphorus and zinc was characterised by these materials using 3 analytical techniques: X-ray Diffraction, Fourier-Transform Infrared Spectroscopy and Scanning Electron Microscopy. Other experiments will be conducted to study its controlled-release behaviour.
- The project team successfully optimised the synthesis process, both with and without the addition of a surfactant.
- They also conducted tests to evaluate the slow nutrient release of biochar-clay mixtures made with attapulgite clay. Phosphorus bonded to calcium, magnesium and organic carbon. Higher clay content is the main control factor for the slow release of phosphorus.
- A biochar-clay composite that was made earlier is being produced in large amounts for glasshouse experiments.



Project 3.1.007

Project leader: Professor Ajayan Vinu,
University of Newcastle

Duration: 2021–2026

Participating organisations:

- University of Newcastle
- NSW Department of Primary Industries and Regional Development
- Murdoch University
- Western Australian No-Tillage Farmers Association
- Andromeda Metals Limited
- Peats Soil

Results and findings

- The synthesis process resulted in a high nutrient loading of approximately 10% phosphorus and 3.5% zinc. The final products demonstrated controlled nutrient release characteristics, which are promising for improving nutrient use efficiency.

Next steps

- The project is transitioning to the next phase of research, which involves plant pot experiments to evaluate agronomic performance.
- In addition to standard pot trials, a rhizobox experiment is also planned. This trial will specifically assess the effectiveness of the surfactant in mitigating phosphorus stratification in soil.
- The project team will aim to validate the field application of the developed fertilisers and strengthen the impact of their ongoing research.
- For the biochar-clay mixtures, phosphorus diffusion tests in soil will be conducted to evaluate nutrient release under realistic soil conditions. The results will provide insights into the material's effectiveness in the targeted agronomic environment.

Organic-based nitrogen fertilisers for crop production and soil health

About the project

In Australia, nitrogen fertiliser use has increased by over threefold in the past 3 decades to meet food production demand. Less than half of nitrogen fertiliser is taken up by plants, so improving nitrogen use efficiency (NUE) is critical for delivering food security and net zero emissions targets.

Soil CRC researchers have developed 3 novel organic-based slow-release urea fertilisers, using peanut shell biochar, cow manure, and green waste compost as an outer coating. These formulations have shown to have higher NUE, higher crop yield and less soil nitrogen losses than conventional urea-nitrogen fertilisers under small-scale glasshouse trials.

This project is scaling up the manufacturing of these innovative fertilisers and carrying out large-scale glasshouse and field trials to optimise usage and placement across different cropping systems, agroclimatic conditions and soil types. Recommendations will be made for broader application by farmers.

Activities

- The 3 organic-based fertiliser recipes were refined and the fertilisers produced in collaboration with Mort & Co Fertilisers.
- Soil samples were collected from the 3 field trial sites in Burdekin (Qld), Condobolin (NSW) and Birchip (Vic) and the physiochemical properties analysed to create a dataset.
- The glasshouse experiment was established in an indoor growth chamber to test the NUE of the novel fertilisers, as well as their potential impacts on soil and environmental health.
- The field trials were established at all 3 sites. An experimental field with low soil-available nitrogen was selected based on the soil test results for the trial establishment.
- A detailed field protocol was developed in consultation with all partners to guide the field trial for the 2025 growth season.



Project 3.1.009

Project leader: Dr Yunying Fang,
Griffith University

Duration: 2024–2027

Participating organisations:

- Griffith University
- Charles Sturt University
- Birchip Cropping Group
- Burdekin Productivity Services
- Central West Farming Systems

- Winter wheat was sown in the last week of May 2025 at both the Condobolin and Birchip sites, following a major rainfall event.
- Sugarcane was planted in mid-May 2025 at the Burdekin site.
- A trial is underway to help improve the manufacturing techniques used for the fertiliser granules with the aim of making them easier to apply at a large scale.

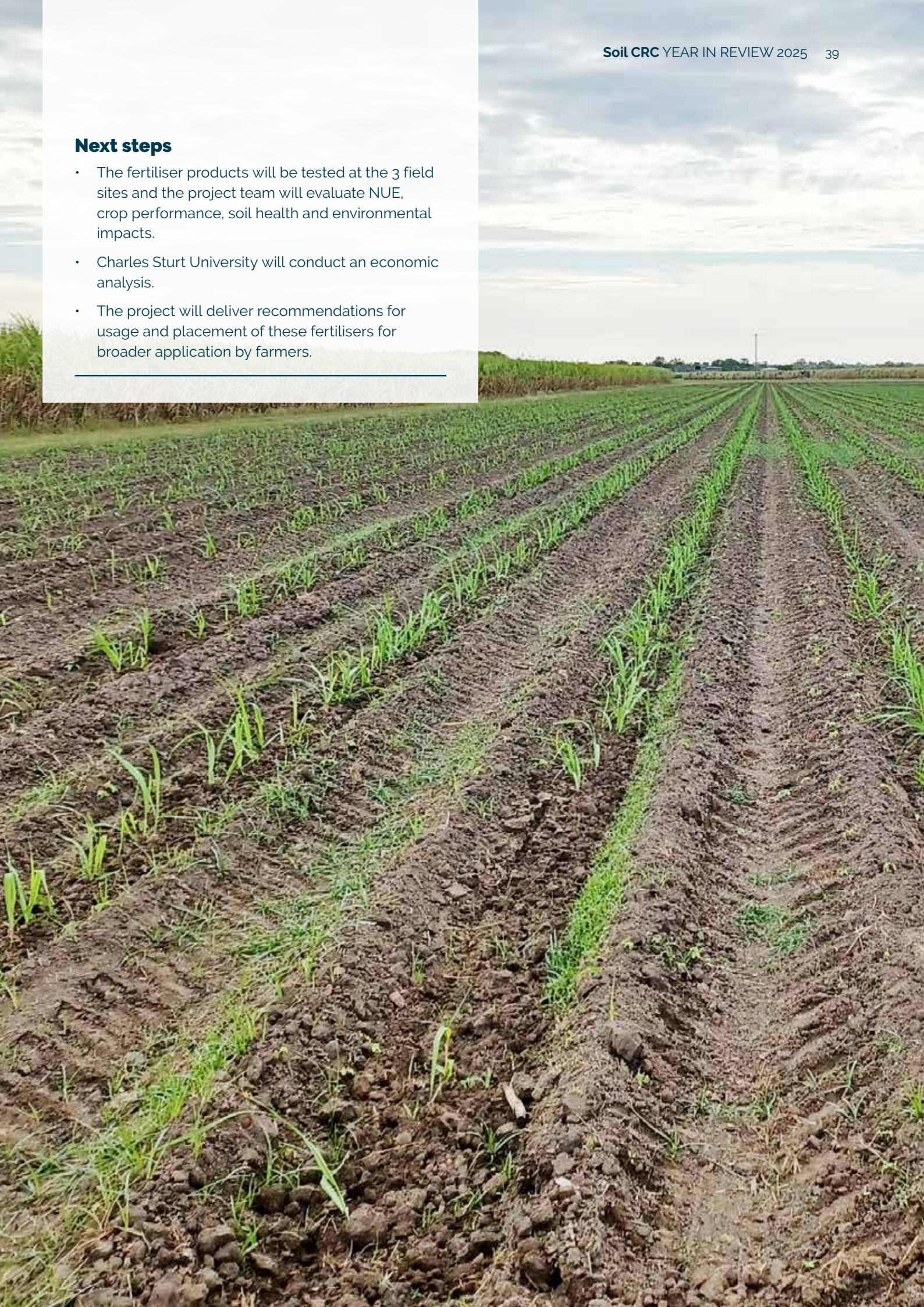
Results and findings

For the winter wheat at the Condobolin trial, plant biomass sampling and Normalised Difference Vegetation Index (NDVI) measurement has been conducted at the stem elongation (GS30) stage. At this early growth stage:

- There were no significant differences in plant biomass or vegetation density among all treatments.
- Green waste-based and biochar-based fertilisers increased plant biomass (compared to the control).
- All 3 organic-based fertilisers increased plant health and vegetation density as indicated by NDVI read results (compared to the control).

Next steps

- The fertiliser products will be tested at the 3 field sites and the project team will evaluate NUE, crop performance, soil health and environmental impacts.
 - Charles Sturt University will conduct an economic analysis.
 - The project will deliver recommendations for usage and placement of these fertilisers for broader application by farmers.
-



New organic amendments for retaining soil moisture

About the project

Commercially available water-retention materials include surfactants, which help to reduce soil water repellence and improve soil wetting processes. However, the effectiveness and environmental risk of some of these materials is unknown.

This project developed cost-effective, environmentally friendly moisture retention materials that will enable farmers to increase their soil's productivity and profitability.

The project team created a range of innovative products by evaluating, modifying and activating naturally occurring, locally available organic- and clay-based materials. These new products can enhance soil moisture capture and retention, and improve seed germination, crop establishment and farming activity under dry conditions.

The results of this project are expected to be widely integrated into standard crop production systems in various regions.

Activities

- The project activities wrapped up in 2024–25 and the project team continued working on journal papers to publish the research findings.
- Soil CRC PhD student Sundus Saeed is continuing her research on cellulose-based moisture retention materials and her doctoral thesis.

Results and findings

- Testing 49 locally available organic- and clay-based materials revealed that oaten hay, brewery fruit waste, and sodium bentonite performed best unmodified, while sphagnum and banana waste had greater absorption.
- Acrylamide-modified eucalyptus bark, pinewood bark, bagasse, beer waste grains, vermiculite and perlite improved water absorption from 10 to more than 100 times, aiding wheat growth, with eucalyptus bark and bagasse resins showing exceptional promise.
- Oxidation/alkali treatments boosted lignocellulosic waste retention, and partial delignification enabled stable, high-performance water-retentive bark composites.



Project 3.3.004

Project leader: Professor Chengrong Chen, Griffith University

Duration: 2021–2025

Participating organisations:

- Griffith University
- University of Newcastle
- Australian Organics Recycling Association
- Western Australian No-Tillage Farmers Association
- Herbert Cane Productivity Services
- Queensland Farmers Federation
- Mort & Co

Next steps

- Further expanding the local directly available organic- and clay-based water-retention materials will be a very meaningful study in the future, especially for farmers who want to achieve simple water-retention effects with more economical methods.
- Further field experiments are recommended to verify the reliability of the novel water-retaining resins prepared in this study in pot trial experiments.
- The Soil CRC is assessing potential pathways for product commercialisation to build on the success of this research.

Building soil resilience and carbon through plant diversity

About the project

Many farmers are looking to build their soil resilience to sustainably improve productivity in an increasingly variable climate. This project aims to identify agronomic interventions that farmers can use to increase plant diversity in cropping systems and thereby improve soil resilience to sustain or increase productivity.

The research builds on a previous Soil CRC project, which assessed a range of agronomic strategies to increase plant diversity in cropping systems, including crop rotation, intercropping, temporary intercropping, pasture (ley) phases and cover cropping.



While the impacts on short-term changes to soil function, soil water balances and crop yields have been quantified, the longer-term impacts of these strategies on soil resilience and soil carbon dynamics, as well as productivity, remain unknown.

The project is using 4 existing long-term field trials in Victoria, Queensland and New South Wales to investigate how much organic material from cover crop and intercrop species is stabilised in soil and how it contributes to soil aggregation.

Activities

- Biomass and soil samples were collected and analysed prior to harvest at each site.
- All 2024 winter crop trials were harvested and samples processed.
- Field data from the 2024 summer season was collated and the 2025 winter crops sown.
- Central West Farming Systems held a field day in October 2024 showcasing the trial site and results to date.



Project 4.1.007

Project leader: Professor Terry Rose, Southern Cross University

Duration: 2023–2026

Participating organisations:

- Southern Cross University
- NSW Department of Primary Industries and Regional Development
- Central West Farming Systems
- Riverine Plains
- Birchip Cropping Group
- Herbert Cane Productivity Services

Results and findings

The treatments used across both the earlier project and this one are yet to improve soil health or carbon. This is likely because the summer cover crops and temporary intercropping have not created a large amount of additional biomass. Conversely, significant yield penalties have not been seen either.



Next steps

Building soil carbon, health and resilience takes time. Due to the long-term nature of these trials, the project team expects to see improvements as the project progresses.

Moving forward, they will explore other measures related to soil resilience, such as disease loads, aggregation, infiltration and nitrogen fixation.

Capitalising on established field trials for ameliorating (sub) soil constraints

About the project

This project builds on 6 long-term field trials established by 3 Soil CRC projects to capitalise on the investment in these sites and extend our investigations across 4 cropping seasons. The sites are based in Western Australia (sandy soil), New South Wales (sodic clay soil) and Queensland (compacted soil).

The outcomes of the project are expected to improve current methods to ameliorate subsoil constraints through development of new and more effective practices. This will enable more efficient use of soil water across a range of Australian farming systems.

Activities

- Crops were grown at each of the long-term field sites in Kweda (WA), Bullaring (WA), Wathingarra (WA), Lockhart (NSW) and Burdekin (Qld). Field experiments were successfully harvested and the sites maintained.
- Sampling programs were implemented for each site. Soil sampling was undertaken and the data analysed to understand the treatment effects.
- Normalised Difference Vegetation Index (NDVI) data (used to measure vegetation health) and weather data were received and analysed.
- Soil samples were taken prior to seeding in early 2025 - the Kweda site was seeded with oat, the Bullaring site was seeded with canola, and the Lockhart and Wathingarra sites were sown with wheat. The first ratoon sugarcane crop continues to grow at the Burdekin site.
- Significant progress was made on the project's biophysical model, which will help to evaluate the long-term effects of the amelioration techniques.



Project 4.2.006

Project leader: Emeritus Professor Richard Bell, Murdoch University

Duration: 2024–2027

Participating organisations:

- Murdoch University
- NSW Department of Primary Industries and Regional Development
- Burdekin Productivity Services
- West Midlands Group
- Facey Group
- Corrigin Farm Improvement Group
- Primary Industries and Regions South Australia

Results and findings

Bullaring – The crop at this site is showing differences among the treatments in terms of leaf area and biomass. Prior crop sequences and serradella treatments are standing out so far in the season. The plant-based treatments (crop sequences and serradella) also stood out in terms of other soil and plant nutrient levels.

Kweda – The Bednar and compost + Bednar treatments had 4 t/ha more oat biomass than the control, but the difference was not statistically significant. Similarly, the compost + Bednar treatment produced more total organic carbon (TOC) than the control in the 10–30 cm soil profile, but conventional statistical analysis did not detect a significant difference.





In the small plots experiment, the high-rate ironman gypsum + Bednar and high-rate compost + Bednar accumulated 4 t/ha more biomass than the control (Bednar only). The hydrotalcite + Bednar, and compost + Bednar each sequestered 4 t/ha more TOC than the control (Bednar only) in the top 10 cm profile. The compost + Bednar and Agrisilica chip + Bednar treatments stood out for increasing nitrogen, phosphorus, potassium and sulphur levels.

Wathingarra – Deep soil amelioration treatments – such as mouldboarding and rotary spading – continue to show positive legacy effects on crop establishment and biomass 4 years after implementation. Organic and mineral amendments (e.g. compost, biochar + frass, gypsum) show incremental benefits to plant nutrition and biomass, though these effects appear more variable than amelioration. Compost consistently increased nitrogen, phosphorus and potassium levels in wheat shoots at early tillering compared to nil or ironman gypsum, indicating its role in improving soil fertility. Biochar + frass also lifted phosphorus and potassium concentrations, suggesting its potential to complement amelioration strategies.

Lockhart – The 2025 crop data recorded so far at the site does not show any significant differences among the treatment, even though the NDVI data shows a trend of greater plant leaf cover in the treatments such as deep organic matter + liquid gypsum application, relative to the control. The treatment differences, in terms of the crop yield, have been observed only in 2023 with the deep organic matter + carbon coated gypsum and deep organic matter + gypsum treatments producing 1.8 t/ha more wheat than the control.

Burdekin – In terms of the leaf nitrogen content, no significant differences were observed among treatments. All the treatments were below the critical nitrogen value for the crop stage, however the yield did not suffer. In terms of the yield data recorded in 2025, no significant differences were found among the treatments, though the mud + gypsum treatment had consistently higher tonnes across all the plots.

Next steps

The project team will continue to monitor the experiments at each site. The Bullaring, Kweda, Lockhart and Wathingarra sites will be harvested in late 2025 and the Burdekin site in mid-2026.

Optimising soil constraint management through computer-based learning and modelling

About the project

Australian cropping soils are frequently affected by multiple interacting constraints – such as sodicity, acidity, compaction and water repellence – that limit productivity and resilience. These problems vary across paddocks and with depth, making them difficult to diagnose and manage. Tackling one issue at a time often fails to deliver lasting improvements. Identifying and treating multiple constraints together is more likely to improve productivity and soil resilience.

This project brought together data analysis, field trials and crop modelling to improve how soil constraints are managed in Australian cropping systems. It developed a knowledge-guided, rule-based framework that can recommend the most effective management strategies for soils affected by multiple constraints.

Activities and findings

- The project team systematically reviewed studies on physical and chemical soil interventions in dryland cropping and their impacts on agricultural productivity and soil functions.
- Soil CRC field trial datasets were compiled and harmonised using reproducible workflows, ensuring data fidelity for modelling.
- Methods were developed to convert digital soil mapping (DSM) products (ISRIC SoilGrids and Soil and Landscape Grids of Australia) into Agricultural Production Systems sIMulator (APSIM)-compatible soil profiles, with benchmarking against the APSOIL Database revealing an underestimation of plant-available water in Vertosols.
- APSIM modelling was used with DSM-derived soil profiles to simulate crop responses to subsoil constraints (sodicity in the Northern Grains Region and water repellence in the Western Grains Region), including preliminary simulations of current Soil CRC field trials.



Project 4.3.006

Project leader: Dr Chloe Lai,
University of Southern Queensland

Duration: 2023–2025

Participating organisations:

- University of Southern Queensland
- Riverine Plains
- Burdekin Productivity Services
- West Midlands Group
- Mallee Sustainable Farming

- Simulations revealed that crop type, rotation, and sowing time strongly influence how soil constraints affect yield. Amelioration strategies need to consider the farming system as well as the constraints.
- The team proposed a knowledge-guided, rule-based modelling framework integrating empirical data, APSIM outputs, and soil diagnostics (e.g. exchangeable sodium percentage, electrical conductivity, pH, texture) to provide site-specific integrated soil amelioration strategies.
- Amelioration recommendations generated by models need validation through soil testing and on-farm trials, particularly when based on modelled soil data rather than locally measured site data.

Next steps

The next phase of this research will integrate the knowledge-guided framework into digital decision-support tools being developed within the Soil CRC (Project 4.3.007). To support adoption, the tools will be co-designed with end users, including grower groups, advisors and regional soil coordinators. This process will help ensure the tools are practical, fit with farm decision cycles and deliver outputs in a useful format. Demonstration trials and workshops will further test and refine the tools while supporting extension and training.

Next generation tools for higher performing soils

About the project

Soil constraints affect 77% of Australian soils, costing producers over \$1,900 million in lost production. There are considerable grower and national benefits from addressing soil constraints through amelioration and reengineering of soils in an economically appropriate manner.

This project brings together the Soil CRC's soil constraint and amelioration modelling to create a new decision support tool for growers and their advisors. This tool will help guide on-farm soil amelioration and reengineering decisions.

The project team will work with next and end users to co-design and validate this next generation tool, ensuring they are practical and useable.

Activities

- Testing servers were established in the ARDC Nectar Research Cloud and proposed wire frames were developed for the tool.
- The project team has been working on the interface design and the conceptualisation of the scientific framework linking the components of previous projects together.
- As part of the validation process, the team collated the historical field trial data provided by participating grower groups.
- The grower group participants implemented the field sites to provide new data for 2025.

Next steps

The effectiveness of the decision support tool will be tested through on-farm validation with Soil CRC grower group participants and retrospective analysis of past amelioration experiments.

The final tool will be promoted to encourage broad uptake within Australian agriculture, enabling farmers and their advisors to make informed decisions about addressing soil constraints in the most economically viable way.



Project 4.3.007

Project leader: Professor Keith Pembleton, University of Southern Queensland

Duration: 2024–2027

Participating organisations:

- University of Southern Queensland
- Federation University Australia
- Charles Sturt University
- Riverine Plains
- West Midlands Group
- Liebe Group
- Mallee Sustainable Farming
- Burdekin Productivity Services

PhD student program





The Soil CRC's PhD student program underpins our 4 research programs to build capability in the future of Australia's soil research.

In 2024–25, we welcomed 1 new PhD student and saw 8 students complete their PhDs, bringing the total number of active students to 32 and the total number of completions to 15.

With 6 students having submitted their theses and all PhD positions now filled, the Soil CRC is well on the way to reaching its target of 40 PhD completions by the end of the CRC.

Our student cohort

Our PhD cohort brings together a huge wealth of knowledge, experiences, professional networks and capabilities for our students to engage with and learn from.

Students are enrolled at 12 universities across Australia, are aged between 26 and 76 years, and reflect a wide range of disciplines and cultural backgrounds.

Highlights and achievements

- **Reuben Mah** from the University of Tasmania completed his PhD in September 2024.
- **James O'Connor** from the University of Western Australia completed his PhD in September 2024.
- **Win Win Pyone** from Murdoch University completed her PhD in December 2024.
- **Suman Gajurel** from the University of Southern Queensland submitted his thesis in July 2024 and completed his PhD in February 2025.
- **Maria Pfeifle** from Murdoch University submitted her thesis in December 2024 and completed her PhD in March 2025.
- **Melissa Wales** from Charles Sturt University completed her PhD in March 2025.
- **Peter Weir** from Federation University Australia completed his PhD in April 2025.
- **Maryam Barati** from Southern Cross University submitted her thesis in December 2024 and completed her PhD in June 2025.
- **Four students submitted their theses** – Salini Khuraijam (University of Newcastle), Phillip Kay (University of Tasmania), Cameron Copeland (Southern Cross University) and Naveeda Majid (University of Newcastle).
- **Twenty-five current and completed students published their research** in 16 journal articles and 17 conference papers in 2024–25.
- **Twenty-eight students presented their research** at the 2024 Soil CRC Participants Conference in Wagga Wagga, NSW. There were 10 oral presentations and 22 posters prepared for display.
- The annual **Soil CRC PhD Workshop Day** took place in conjunction with our 2024 Participants Conference – 30 students and recent graduates from 12 universities attended the workshop. It featured two engaging panel sessions with research and industry leaders, an insightful Q&A session, and a guided tour of the nearby NSW Department of Primary Industries and Regional Development (DPIRD) research facilities.
- **More than 20 Soil CRC students attended the student welcome function** at the 2024 Participants Conference, which provided an opportunity to network with Soil CRC Board, program leaders and staff.



In their words

"The fascinating array of knowledge that is gained by hearing details of other candidates' research, and the opportunities to network and make soil buddies who are doing the same (yet very different) research at the same time, as well as meeting people in wider research and related stakeholders, has been invaluable."

Christopher Wilmot, Charles Sturt University

"Grateful to the Soil CRC for helping me fulfil my dream and giving me the opportunity to contribute to soil research."

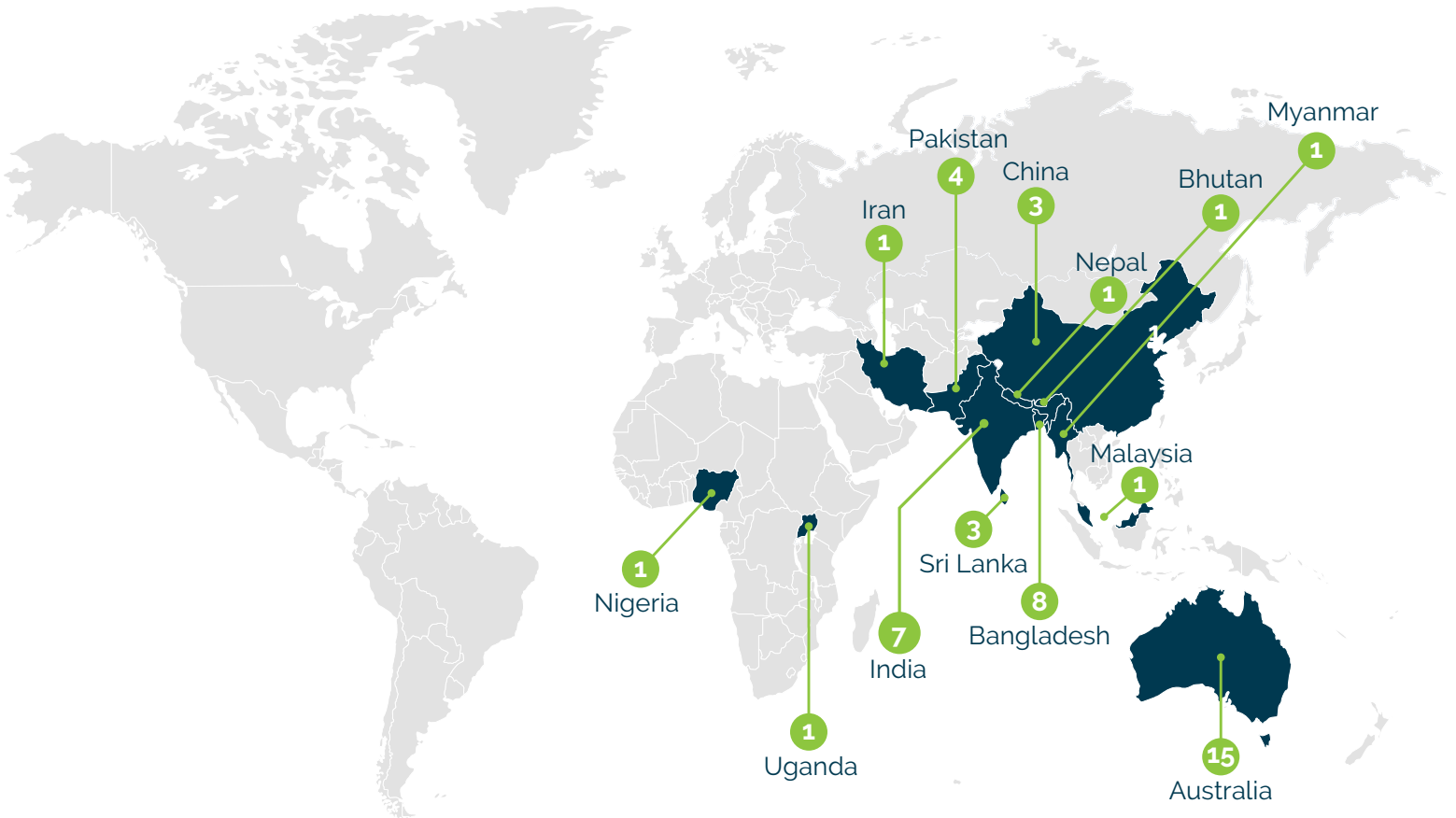
Tania Monir, Murdoch University

"Their [the Soil CRC's] prospect to keep students as the top priority builds so much confidence in international students to work on their PhD more openly, without fear or hesitation to express their ideas with supervisors, ultimately making us realise we have someone to support us whatever the consequences will be."

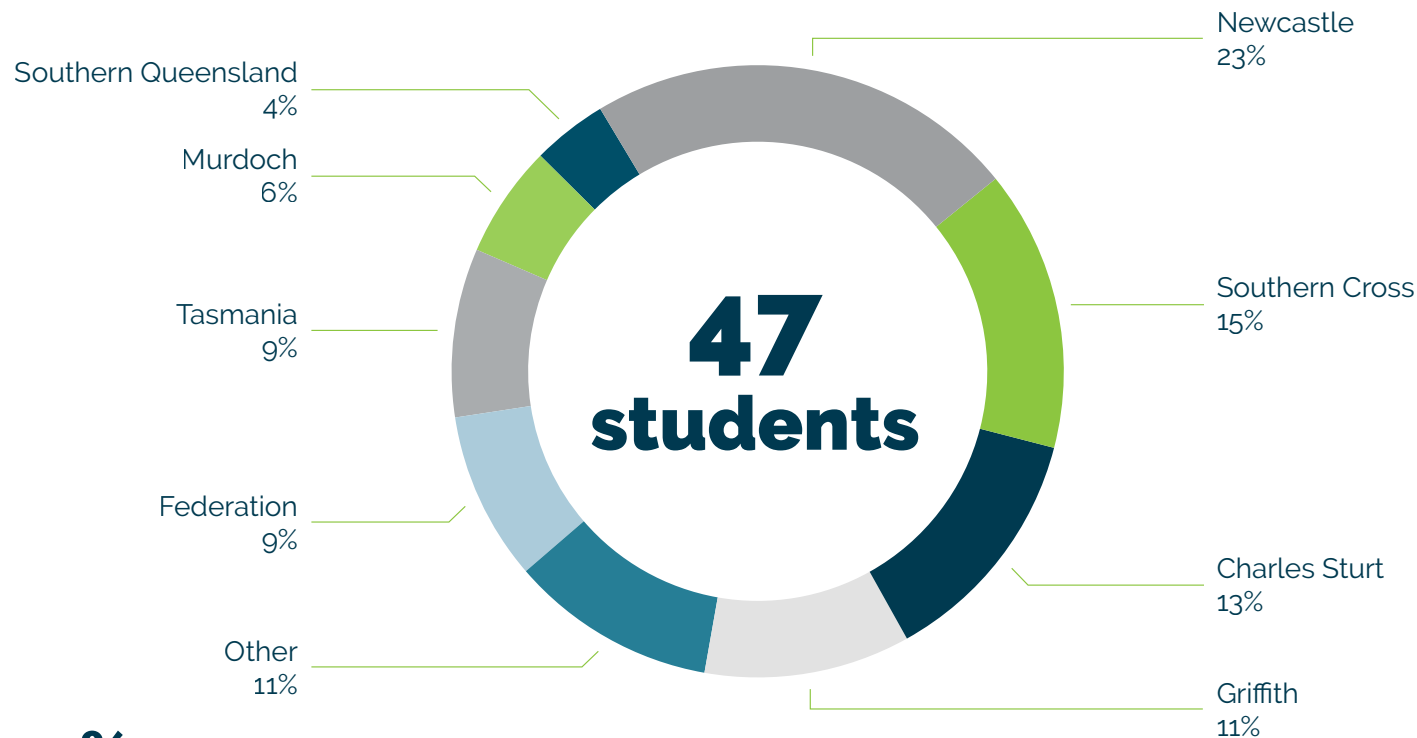
Vijay Aralappanavar, University of South Australia



Country of origin



Students by university



Our PhD students

Student	University	PhD title	Program
Completed			
Sepide Abbasi	University of Newcastle	Phosphorus release and labile phosphorus from iron phosphate and biochar in rhizosphere induced by root exudates	3
Mathew Alexanderson	Southern Cross University	The Trojan Horse is all Greek to me! Exploring the social boundaries of regenerative agriculture	1
Maryam Barati	Southern Cross University	Improving phosphorus acquisition in grain crops with organic amendments	3
Suman Gajurel	University of Southern Queensland	Modelling and diagnosis of multiple soil constraints across Australian farming systems	4
Md. Zahangir Hossain	University of Newcastle	Biochar and nutrient interactions	3
Xiangyu Liu	Griffith University	Developing sensitive soil health indicator of Australia agricultural land	4
Henry Luutu	Southern Cross University	Optimisation of hydrothermal carbonisation-treated wastes for use as novel soil amendments	3
Reuben Mah	University of Tasmania	3D printed devices for in-field soil measurements	2
James O'Connor	University of Western Australia	Enhanced nutrient recovery from food waste anaerobic digestate	3
Maria Pfeifle	Murdoch University	Proximal sensing in soil water repellency management	2
Win Win Pyone	Murdoch University	Managing phytotoxicity of soil borne herbicide residues in grain cropping systems	4
Md. Aminur Rahman	University of Newcastle	Biochar modification for the generation of high quality phosphorus fertiliser products	3
Rahat Shabir	Griffith University	Developing effective biochar and biopolymer material as an alternative microbial carrier	3
Melissa Wales	Charles Sturt University	Social norms of soil management	1
Peter Weir	Federation University Australia	In-paddock variability of plant available water	2

Student	University	PhD title	Program
Active 2024–25			
Adnan Al Moshi	Federation University Australia	Next generation below ground sensor communication using seismic waves for smart soil applications	2
Vijay Aralappanavar	University of South Australia	Diffusive Gradient in Thin-films methodology for assessing bioavailability of soil herbicide residues	4
Cameron Copeland	Southern Cross University	Understanding the mechanisms of soil microbial function and their role in cropping systems	4
Dristi Datta	Charles Sturt University	Developing a hyperspectral imagery-based decision support system for soil assessment using vegetation pattern	2
Louise Hunt	Southern Cross University	Negotiating the complexities of farming in the 21st century	1
Chenting Jiang	University of Tasmania	Machine learning the soil water function	2
Harleen Kaur	University of Newcastle	Biochar functionalisation to derive as P enriched fertilizer	3
Phillip Kay	University of Tasmania	Microbial changes associated with improved or reduced soil health	2
Muhammad Salik Ali Khan	University of Tasmania	Development and optimization of soil health chip: An affordable device for rapid field-based assessment of soil fertility status	2
Salini Khuraijam	University of Newcastle	Exploring economic aspects of adopting soil amendments for ameliorating soil constraints in Australia	1
Stephen Lang	University of Adelaide	Impacts of soil modification on roots and the rhizosphere	4
Naveeda Majid	University of Newcastle	Non-wetting soils: the cause, mechanism of non-wetting and remediation	4
Evanna McGuinness	Southern Cross University	Soil organic carbon and nitrogen dynamics in topsoils and subsoils of grazing systems of the Northern Rivers region of NSW	2

Student	University	PhD title	Program
Active 2024–25			
Bhavya Mod	University of Newcastle	Carbon storage in soil using agro industry biowaste	3
Tania Monir	Murdoch University	Stability of soil carbon under different amendments in sandy soils	3
Kamrun Nahar	Griffith University	Enhancing soil resilience to alkaline sodicity and acidity constraints to improve soil productivity	4
Sadia Sabrin Nodi	Charles Sturt University	Development of a grower focused mobile app for estimating, analysing and recording soil properties	2
Oluwadunsin Oyetunji	RMIT University	Value of compost-blended fertilizer products to boost nutrient-use efficiency and productivity in broadacre farming systems	3
Thilakshi Maheshika Paranavithana	Griffith University	Impacts of organic amendments on soil carbon sequestration: Soil type, type of amendment & climatic condition	3
Kalani Randima Lakshani Pathira Arachchilage	University of Newcastle	Toward digital mapping of soil moisture	2
Vibin Perumalsamy	University of Newcastle	Reconciling carbon sequestration with fertiliser value of biowastes in farming systems through nanostabilisation of biowastes	3
Mohammad Arifur Rahman	Federation University Australia	Enhancing soil organic carbon estimation through hyperspectral dimensionality reduction	2



Student	University	PhD title	Program
Active 2024–25			
Pradeep Rai	Charles Sturt University	Economic, social, and environmental contrasts of regenerative agriculture in Australian farming context	1
Sundus Saeed Qureshi	Griffith University	Developing novel cellulose-based moisture-retaining materials to mitigate drought in the soil system	3
Rohan Samaratunga	University of Newcastle	Developing next generation biofertilizers for enhancing soil health & crop productivity towards resilient & climate smart agriculture	3
James Sargeant	Federation University Australia	Estimating soil organic carbon using physics informed neural networks	2
Prasanthi Sooriyakumar	University of Western Australia	Managing soil carbon to increase soil productivity	3
Hayden Thompson	Southern Cross University	The impact of temporary legume intercropping on soil water balance and wheat yields	4
Mohd Arish Usman	University of Newcastle	Design and development of advanced biochar-clay composite	3
Christopher Wilmot	Charles Sturt University	Certifying soil stewardship management practices through the consumer market	1
Linda Wirf	Charles Sturt University	Beyond adoption: Gendered knowledges in agricultural practice change in Australia	1
Hanlu Zhang	University of Southern Queensland	Soil-moisture profile dynamics affected by cover crop: Effect of changes in soil biology and structure	4



Our people

The Soil CRC is governed by a skills-based Board of Directors with an independent Chair, 4 independent members and 4 non-independent members. The Board provides oversight of the Soil CRC activities, performance and strategic direction.







Soil CRC Board

- **Dr Paul Greenfield AO FTSE**
Chair
- **Professor Andrea Bishop**
Non-independent Director
- **Dr Peter Carberry FAIAST FTSE FNAAS**
Independent Director (from August 2024)
- **Dr Nathan Craig**
Non-independent Director
- **Professor Michael Friend**
Non-independent Director
- **Ralph Hardy**
Independent Director
- **Kate Lorimer-Ward**
Non-independent Director
(until November 2024)
- **Robbie Sefton AM**
Independent Director
- **Dr Simon Speirs**
Independent Director
- **Distinguished Professor Helen Thompson**
Non-independent Director
(from November 2024)

The Board has 5 committees that govern research, finance and risk, nominations, remuneration, and intellectual property and commercialisation.

The CEO reports to the Board on management of the Soil CRC. The CEO leads a team that operate the Soil CRC.



Soil CRC Patron

The Honourable Penelope Wensley AC is the Patron of the Soil CRC. She is also Patron of Soil Science Australia and works closely with both organisations to help promote Australia's strengths and capabilities in soil science and related disciplines, both nationally and internationally.



Program Leaders

Our 4 Program Leaders oversee and implement the research direction of the Soil CRC.

- **Professor Catherine Allan** – Program 1 Leader, Charles Sturt University
- **Associate Professor Richard Doyle** – Program 2 Leader, University of Tasmania (until January 2025)
- **Dr Nathan Robinson** – Program 2 Leader, Federation University Australia (from February 2025)
- **Professor Megharaj Mallavarapu** – Program 3 Leader, University of Newcastle
- **Dr Lukas Van Zwieten** – Program 4 Leader, NSW Department of Primary Industries and Regional Development

Soil CRC Staff

- **Dr Michael Crawford**
Chief Executive Officer
- **Mark Flick**
Chief Financial Officer
- **Dr Rhona Hammond**
Intellectual Property Officer
- **Felicity Harrop**
Soil Knowledge Broker
- **Olivia Louis**
Communications Manager
- **Jodi McLean**
Chief Operating Officer
- **Sandy Slater**
Finance Officer
- **Kathy Stokes**
Executive Assistant to the CEO
- **Dr Cassandra Wardle**
PhD Program Manager
- **Dr Lucy Weaver**
Research Administration Officer



Financial summary

As extracted from the annual audited Financial
Statements for the year ended 30 June 2025.



Profit or Loss

For the Year Ended 30 June 2025

	2025 \$	2024 \$
Revenue	25,470,797	26,667,313
Other income	430,676	525,690
Consultant fees	(105,874)	(77,765)
Employee benefits expense	(720,451)	(651,778)
Finance expenses	(1,332)	(587)
IT expenses	(66,025)	(57,481)
Legal expenses	(8,737)	(600)
Other expenses	(548,301)	(528,170)
Research expenditure - cash	(7,206,389)	(6,466,837)
Research expenditure - in kind	(17,094,079)	(19,348,784)
Travel expenses	(150,285)	(61,001)
Surplus before income tax	-	-
Income tax expense	-	-
Surplus for the year	-	-
Other comprehensive income for the year	-	-
Total comprehensive income for the year	-	-

Participants' Contributions (Cash basis ex GST)

For the Year Ended 30 June 2025

	2025 \$	2024 \$	Cumulative to 2023 \$	Total \$
Agricultural Innovation and Research - Eyre Peninsula				
Cash contributions	0	0	20,000	20,000
In-kind contributions				
- Staff	32,500	30,000	172,000	234,500
- Other	28,777	23,800	120,020	172,597
Total	61,277	53,800	312,020	427,097
Australian Organics Recycling Association Limited				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	2,500	32,500	181,250	216,250
- Other	0	0	2,000	2,000
Total	2,500	32,500	183,250	218,250
Birchip Cropping Group Inc				
Cash contributions	5,000	5,000	28,750	38,750
In-kind contributions				
- Staff	70,000	90,000	399,500	559,500
- Other	110,017	69,000	189,303	368,320
Total	185,017	164,000	617,553	966,570
Burdekin Productivity Services Limited				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	132,500	90,000	271,875	494,375
- Other	186,655	55,450	50,340	292,445
Total	319,155	145,450	322,215	786,820
Central West Farming Systems Inc				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	155,000	127,500	575,525	858,025
- Other	203,263	187,608	466,768	857,639
Total	358,263	315,108	1,042,293	1,715,664
Charles Sturt University				
Cash contributions	250,000	150,000	1,200,000	1,600,000
In-kind contributions				
- Staff	1,067,500	1,037,500	3,878,250	5,983,250
- Other	554,054	490,606	1,879,124	2,923,784
Total	1,871,554	1,678,106	6,957,374	10,507,034

	2025 \$	2024 \$	Cumulative to 2023 \$	Total \$
Corrigin Farm Improvement Group				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	55,000	70,000	72,500	197,500
- Other	207,126	157,360	58,298	422,784
Total	262,126	227,360	130,798	620,284
Department of Energy, Environment and Climate Action (VIC)				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	10,000	30,000	1,163,750	1,203,750
- Other	0	33,750	528,587	562,337
Total	10,000	63,750	1,692,337	1,766,087
Department of Primary Industries and Regional Development (NSW)				
Cash contributions	75,000	0	525,000	600,000
In-kind contributions				
- Staff	1,457,500	467,500	4,620,500	6,545,500
- Other	358,601	436,636	2,506,208	3,301,445
Total	1,891,101	904,136	7,651,708	10,446,945
Department of Primary Industries and Regions (SA)				
Cash contributions	200,000	0	600,000	800,000
In-kind contributions				
- Staff	117,500	1,322,500	786,325	2,226,325
- Other	46,502	494,988	1,081,953	1,623,443
Total	364,002	1,817,488	2,468,278	4,649,768
Facey Group Inc				
Cash contributions	5,000	6,250	28,750	40,000
In-kind contributions				
- Staff	87,500	142,500	808,725	1,038,725
- Other	71,996	61,308	61,750	195,054
Total	164,496	210,058	899,225	1,273,779
Farmlink Research Limited				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	37,500	17,500	97,200	152,200
- Other	3,000	22,785	42,549	68,334
Total	40,500	40,285	139,749	220,534

Participants' Contributions (Cash basis ex GST) *cont.*

	2025 \$	2024 \$	Cumulative to 2023 \$	Total \$
Federation University Australia				
Cash contributions	100,000	100,000	600,000	800,000
In-kind contributions				
- Staff	782,500	1,097,500	3,067,800	4,947,800
- Other	672,901	623,200	1,524,882	2,820,983
Total	1,555,401	1,820,700	5,192,682	8,568,783
Griffith University				
Cash contributions	100,000	100,000	600,000	800,000
In-kind contributions				
- Staff	627,500	430,000	2,190,750	3,248,250
- Other	538,667	636,752	1,687,283	2,862,702
Total	1,266,167	1,166,752	4,478,033	6,910,952
Hart Field Site Group Incorporated				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	37,500	35,000	121,450	193,950
- Other	21,250	15,000	185,842	222,092
Total	58,750	50,000	307,292	416,042
Herbert Cane Productivity Services Limited				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	105,000	290,000	399,500	794,500
- Other	35,670	64,420	183,363	283,453
Total	140,670	354,420	582,863	1,077,953
Holbrook Landcare Group				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	45,000	90,000	149,000	284,000
- Other	3,750	3,500	4,761	12,011
Total	48,750	93,500	153,761	296,011
Manaaki Whenua Landcare Research (New Zealand)				
Cash contributions	0	0	1,202,000	1,202,000
In-kind contributions				
- Staff	5,000	40,000	401,500	446,500
- Other	1,250	13,750	101,864	116,864
Total	6,250	53,750	1,705,364	1,765,364

	2025 \$	2024 \$	Cumulative to 2023 \$	Total \$
MacKillop Farm Management Group Inc				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	2,500	10,000	35,000	47,500
- Other	400	0	6,833	7,233
Total	2,900	10,000	41,833	54,733
Mallee Sustainable Farming Inc				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	40,000	25,000	57,500	122,500
- Other	59,885	8,680	250	68,815
Total	99,885	33,680	57,750	191,315
Murdoch University				
Cash contributions	150,000	150,000	900,500	1,200,500
In-kind contributions				
- Staff	477,500	570,000	1,707,000	2,754,500
- Other	410,680	447,450	1,244,569	2,102,699
Total	1,038,180	1,167,450	3,852,069	6,057,699
North Central Catchment Management Authority				
Cash contributions	0	0	15,000	15,000
In-kind contributions				
- Staff	12,500	15,000	232,500	260,000
- Other	0	0	45,900	45,900
Total	12,500	15,000	293,400	320,900
NSW Environment Protection Authority				
Cash contributions	60,000	0	130,000	190,000
In-kind contributions				
- Staff	5,000	7,500	13,750	26,250
- Other	0	0	0	0
Total	65,000	7,500	143,750	216,250
Nutrien Ag Solutions				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	0	35,000	951,500	986,500
- Other	0	800	84,050	84,850
Total	0	35,800	1,035,550	1,071,350

Participants' Contributions (Cash basis ex GST) *cont.*

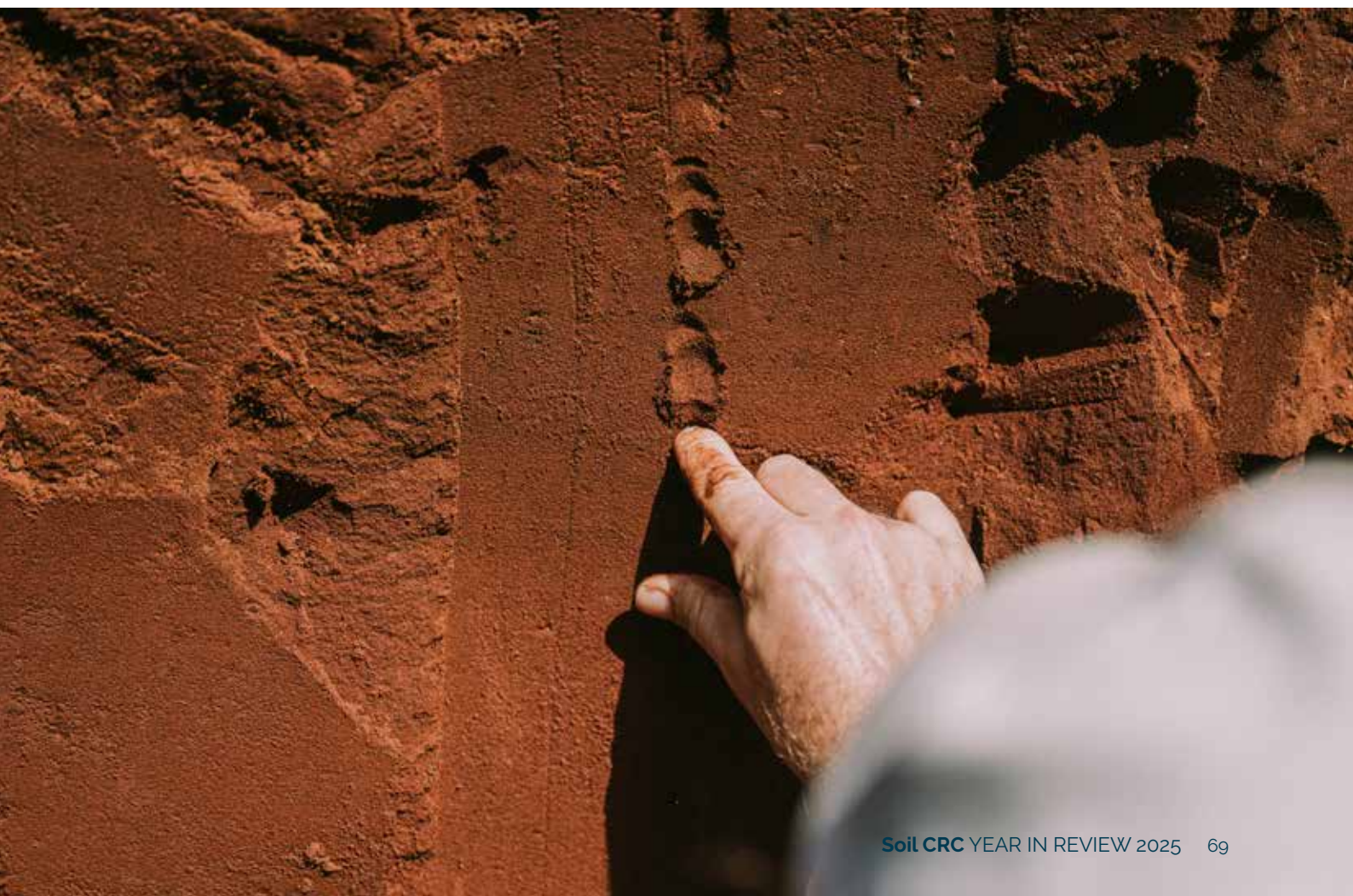
	2025 \$	2024 \$	Cumulative to 2023 \$	Total \$
Riverine Plains Incorporated				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	40,000	45,000	42,500	232,950
- Other	124,861	72,814	27,051	322,184
Total	164,861	117,814	69,551	555,134
South Australian Grain Industry Trust Fund				
Cash contributions	150,000	150,000	900,000	1,200,000
In-kind contributions				
- Staff	0	5,000	117,300	122,300
- Other	750	20,000	42,500	63,250
Total	150,750	175,000	1,059,800	1,385,550
South East Water Corporation				
Cash contributions	30,000	30,000	180,000	240,000
In-kind contributions				
- Staff	75,000	0	436,625	511,625
- Other	378,000	0	164,625	542,625
Total	483,000	30,000	781,250	1,294,250
Southern Cross University				
Cash contributions	250,000	250,000	1,200,000	1,700,000
In-kind contributions				
- Staff	772,500	862,500	4,645,750	6,280,750
- Other	508,127	633,568	3,356,848	4,498,543
Total	1,530,627	1,746,068	9,202,598	12,479,293
Southern Farming Systems Limited				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	92,500	55,000	114,450	261,950
- Other	77,375	12,000	62,793	152,168
Total	169,875	67,000	177,243	414,118
Society of Precision Agriculture Australia (SPAA)				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	0	5,000	78,750	83,750
- Other	0	0	1,960	1,960
Total	0	5,000	80,710	85,710

	2025 \$	2024 \$	Cumulative to 2023 \$	Total \$
The Gillamii Centre				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	0	0	2,500	2,500
- Other	0	0	0	0
Total	0	0	2,500	2,500
The Liebe Group Inc				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	25,000	50,000	65,250	140,250
- Other	81,955	37,500	32,750	152,205
Total	106,955	87,500	98,000	292,455
The Trustee for Soils for Life Trust				
Cash contributions	20,000	20,000	120,000	160,000
In-kind contributions				
- Staff	585,000	605,000	712,775	1,902,775
- Other	22,875	45,230	124,933	193,038
Total	627,875	670,230	957,708	2,255,813
The University of Newcastle				
Cash contributions	225,000	300,000	1,800,000	2,325,000
In-kind contributions				
- Staff	1,200,000	1,447,500	4,839,218	7,486,718
- Other	771,287	1,090,067	3,886,971	5,748,325
Total	2,196,287	2,837,567	10,526,189	15,560,043
University of Southern Queensland				
Cash contributions	150,000	150,000	900,000	1,200,000
In-kind contributions				
- Staff	260,000	352,500	2,347,650	2,960,150
- Other	538,488	588,970	1,462,690	2,590,148
Total	948,488	1,091,470	4,710,340	6,750,298
University of Tasmania				
Cash contributions	112,500	150,000	863,000	1,125,500
In-kind contributions				
- Staff	545,000	667,500	3,900,000	5,112,500
- Other	920,755	1,343,277	3,205,438	5,469,470
Total	1,578,255	2,160,777	7,968,438	11,707,470

Participants' Contributions (Cash basis ex GST) *cont.*

	2025 \$	2024 \$	Cumulative to 2023 \$	Total \$
Western Australian No-Tillage Farmers Association				
Cash contributions	7,500	10,000	60,000	77,500
In-kind contributions				
- Staff	50,000	145,000	558,750	753,750
- Other	40,250	81,875	105,176	227,301
Total	97,750	236,875	723,926	1,058,551
West Midlands Group Incorporated				
Cash contributions	0	0	10,000	10,000
In-kind contributions				
- Staff	137,500	122,500	231,875	491,875
- Other	326,164	200,082	162,666	688,912
Total	463,664	322,582	404,541	1,190,787
Wheatbelt Natural Resource Management Incorporated				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	42,500	32,500	334,625	409,625
- Other	10,500	9,750	174,313	194,563
Total	53,000	42,250	508,938	604,188
Wimmera Catchment Authority				
Cash contributions	0	0	0	0
In-kind contributions				
- Staff	187,500	257,500	652,925	1,097,925
- Other	15,048	34,808	77,897	127,753
Total	202,548	292,308	730,822	1,225,678
Other Third Party				
Cash contributions	1,609,508	757,595	2,426,660	4,793,763
In-kind contributions				
- Staff	187,500	440,000	268,750	896,250
- Other	198,200	137,000	62,889	398,089
Total	1,995,208	1,334,595	2,758,299	6,088,102

	2025 \$	2024 \$	Cumulative to 2023 \$	Total \$
Total Participant Contribution				
Cash contributions	3,499,508	2,328,845	14,309,660	20,138,013
In-kind contributions				
- Staff	9,565,000	11,195,000	41,809,793	62,569,793
- Other	7,529,079	8,153,784	25,105,455	40,788,318
Total	20,593,587	21,677,629	81,224,908	123,496,124
Total Commonwealth Contribution				
Cash contributions	3,282,000	3,548,000	27,638,570	34,468,750
Total	3,282,000	3,548,000	27,638,570	34,468,750
Total Contributions				
Cash contributions	6,781,508	5,876,845	41,948,410	54,606,763
In-kind contributions				
- Staff	9,565,000	11,195,000	41,809,793	62,569,793
- Other	7,529,079	8,153,784	25,103,455	40,786,318
Total	23,875,587	25,225,629	108,861,658	157,962,874



Our publications





Soil amelioration and amendments

Site Aims:

- Evaluate the stacking of multiple soil amendments and amelioration methods to improve soil health, crop growth and yield
- Investigate innovative cropping and mixed farming practices through the lens of drought resilience and risk management

Treatment	Soil	Topsoil	Subsoil	Other
Control	Yes	Yes	Yes	Yes
Rocky loam	Yes	Yes	Yes	Yes
Rocky loam	Yes	Yes	Yes	Yes



Host Farmer: Jeremy Roberts

Site articles - WMG



Refereed journal papers

Alexanderson, M.S., Luke, H. & John, L.D. (2024). Regenerative agriculture in Australia: the changing face of farming. *Frontiers in Sustainable Food Systems*, 8, 1402849. <https://doi.org/10.3389/fsufs.2024.1402849>

Aralappanavar, V., Sarkar, B., Doolette, C.L., Donnellan, L., Mason, S., Rose, M., Hoffmann, P., Zhang, H. & Lombi, E. (2025). Diffusive gradients in thin films (DGT) for measuring potentially bioavailable pesticide residues in soil systems: Current challenges and perspectives. *Critical Reviews in Environmental Science and Technology*, 55(17), 1336–1357. <https://doi.org/10.1080/10643389.2025.2520553>

Culas, R., Anwar, M. R. & Maraseni, T. N. (2025). A framework for evaluating benefits of organic fertilizer use in agriculture. *Journal of Agriculture and Food Research*, 19, 101576. <https://doi.org/10.1016/j.jafr.2024.101576>

Datta, D., Paul, M., Murshed, M., Teng, S.W. & Schmidtke, L. (2025). Hybrid Bayesian Attention Model for estimating soil organic carbon from Landsat 8 satellite data. *Computers and Electronics in Agriculture*, 237, 110406. <https://doi.org/10.1016/j.compag.2025.110406>.

Khurajam, S., Wechtler, H., Higgins, V. & Seshadri, B. (2025). Understanding the impact of identity and socio-economic factors on the adoption of soil conservation practices: Empirical evidence from Australia. *Journal of Rural Studies*, 116, 103636. <https://doi.org/10.1016/j.jrurstud.2025.103636>

Liu, X., Rashti, M.R., Li, D., Van Zwieten, L., Esfandbod, M. and Chen, C. (2025). Wheat straw returning mitigates the impact of crop rotational history on soil respiration response to drought–rewetting cycle. *Land Degradation & Development*, 36(15), 5255–268. <https://doi.org/10.1002/ldr.70003>.

Luke, H. (2025). Designing social surveys for understanding farming and natural resource management: A purposeful review of best-practice survey methods. *Land Use Policy*, 153, 107526. <https://doi.org/10.1016/j.landusepol.2025.107526>

Luutu, H., Rose, M.T., McIntosh, S., Van Zwieten, L. & Rose, T.J. (2024). Probing the toxicity of hydrothermal carbonised wastes on soil biota: Effect of reaction temperature and feedstock. *Chemosphere*, 369, 143857. <https://doi.org/10.1016/j.chemosphere.2024.143857>

Mod, B., Baskar, A.V., Bahadur, R., Tavakkoli, E., Van Zwieten, L., Singh, G. & Vinu, A. (2024). From cane to nano: advanced nanomaterials derived from sugarcane products with insights into their synthesis and applications. *Science and Technology of Advanced Materials*, 25(1). <https://doi.org/10.1080/o/14686996.2024.2393568>

Mohammad, A.R., Teng, S.W., Murshed, M., Paul, M. & Brennan, D. (2024). BSDR: A data-efficient deep learning-based hyperspectral band selection algorithm using discrete relaxation. *Sensors*, 24(23), 7771. <https://doi.org/10.3390/s24237771>

Morrison, M., McKenzie, K., MacDonald, D.H., Small, F., Nayeem, T. & Greig, J. (2025). Connecting consumers and soil: Development of a conceptual model for shaping the consumer market for soil stewardship. *Soil Security*, 19, 100180. <https://doi.org/10.1016/j.soisec.2025.100180>

Nodi, S.S., Paul, M., Robinson, N., Wang, L., Rehman, S.U. & Kabir, A. (2025). Munsell soil colour prediction from the soil and soil colour book using patching method and deep learning techniques. *Sensors*, 25(1), 287. <https://doi.org/10.3390/s25010287>

O'Connor, J., Mickan, B.S., Gurung, S.K., Jenkins, S.N., Siddique, K.H., Leopold, M., Bühlmann, C.H. & Bolan, N.S. (2024). Transforming waste to wealth: Impact of food waste-derived soil amendments and synthetic nitrogen fertilizer on soil dynamics. *Soil Use and Management*, 40(3), e13093. <https://doi.org/10.1111/sum.13093>

Ollerenshaw, A., Dahlhaus, P., Thompson, H. & Staines, C. (2025). The opportunities and challenges associated with establishing a national soil data repository from public and private actors. *Soil Use and Management*, 41(2), e70075. <https://doi.org/10.1111/sum.70075>

Ollerenshaw, A., Thompson, H., Luke, H., Cooke, P., Best, F., Scholz, N., Fear, D., Craig, N., Telfer, J., Wright, A. & Kruger, S. (2025). The application of digital tools for information sharing in agriculture: A longitudinal case study from four Australian grower groups. *Computers and Electronics in Agriculture*, 230, 109843. <https://doi.org/10.1016/j.compag.2024.109843>

Pyone, W.W., Bell, R.W., Rose, M.T. & McGrath, G. (2024). Phytotoxicity risk assessment of diuron residues in sands on wheat, chickpea and canola. *PLOS ONE*, 19(12), e0306865. <https://doi.org/10.1371/journal.pone.0306865>

Qureshi, S.S., Nizamuddin, S., Xu, J., Vancov, T. & Chen, C. (2024). Cellulose nanocrystals from agriculture and forestry biomass: synthesis methods, characterization and industrial applications. *Environmental Science and Pollution Research*, 31, 58745-58778. <https://doi.org/10.1007/s11356-024-35127-3>

Rahman, M., Teng, S.W., Murshed, M., Paul, M. & Brennan, D. (2025). Deep learning-based adaptive-downsampling of hyperspectral bands for soil organic carbon estimation. *IEEE Access*, 13, 95392-95409. <https://doi.org/10.1109/ACCESS.2025.3574697>

Rai, P., Godfrey, S.S., Storer, C.E., Behrendt, K., Ip, R.H.L. & Nordblom, T.L. (2025). Unravelling regenerative agriculture's sustainability benefits and outcomes: A scoping review. *Sustainability*, 17(3), 981. <https://doi.org/10.3390/su17030981>

Senanayake, I.P., Yeo, I.-Y., Robinson, N.J., Dahlhaus, P.G. & Hancock, G.R. (2024). Identification of high-performing soil groups in grazing lands using a multivariate analysis method. *Soil Security*, 16, 100163. <https://doi.org/10.1016/j.soisec.2024.100163>

Then, M., Shemehsavar, S., Henry, D.J. & Harper, R. J. (2025). The effects of climatic and soil properties on the severity of soil water repellency. *CATENA*, 258, 109218. <https://doi.org/10.1016/j.catena.2025.109218>

Weir, P. & Dahlhaus, P. (2024). Beyond soil moisture probes: improving field scale soil moisture mapping. *Discover Soil*, 1, 25. <https://doi.org/10.1007/s44378-024-00025-0>

Conference papers – refereed

Dristi, D., Manoranjan, P., Murshed, M., Teng, S.W. & Schmidtke, L.M. (2024). Unveiling soil-vegetation interactions: Reflection relationships and an attention-based deep learning approach for carbon estimation. *2024 IEEE International Conference on Multimedia and Expo Workshops (ICMEW)*, Niagara Falls, ON, Canada, 15-July 2024. <https://doi.org/10.1109/ICMEW63481.2024.10645460>

Rahman, M., Teng, S.W., Murshed, M., Paul, M. & Brennan, D. (2024). Addressing limitations of common methods in attention-based hyperspectral band selection algorithms. *2024 Digital Image Computing: Techniques & Applications (DICTA)*, Perth, WA, Australia, 27- 29 November 2024. <https://ieeexplore.ieee.org/abstract/document/10869564>

Sargeant, J., Wei Teng, S., Murshed, M., Paul, M. and Brennan, D. (2024). Estimating soil organic carbon from multispectral images using physics-informed neural networks. *17th Asian Conference on Computer Vision (ACCV 2024)*, Hanoi, Vietnam, 8 12 December 2024. https://doi.org/10.1007/978-981-96-0963-5_22

Conference papers – non-refereed

Allan, C. (2025). Ask not what this soil can do for you, but... Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Aralappanavar, V. K., Sarkar, B., Doolette, C.L., Mason, S., Rose, M., Hoffmann, P. & Lombi, E. (2024). Research collaboration leads to cost-effective, renewable organic carriers for rhizobial inoculant. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_885bc87253ba40dabae5e067908ca764.pdf

Aralappanavar, V., Sarkar, B., Doolette, C.L., Mason, S., Rose, M., Hoffmann, P. & Lombi, E. (2024). Diffusive gradients in thin films (DGT) methodology for in-situ measurement of imazamox residues in soil. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_75740ec5d6ee496fb53b5c1d8ab93478.pdf

Channon, J., Friend, J., Huang, X., Robinson, N., Medyckyj-Scott, D. & Clarendon, S. (2024) Exploring and evolving RDM practices for researchers in the small sciences. 2024 eResearch Australasia Conference, Melbourne, VIC, Australia, 28 October-1 November 2024. <https://conference.ersearch.edu.au/exploring-and-evolving-rdm-practices-for-researchers-in-the-small-sciences/>

Dahlhaus, P., MacLeod, A., Ollerenshaw, A., Robinson, N., Wong, M., Thompson, H. & Doyle, R. (2024). Creating a public-private soil data federation: the Visualising Australasia's Soils project. Global Symposium on Soil Information and Data (GSID24), Nanjing, China, 25-28 September 2024. https://www.fao.org/fileadmin/user_upload/GSP/GSID24/Presentations/Day_2_Parallel_Session_5/8_Dahlhaus_VAS_presentation_GSID24.pdf

Dahlhaus, P., MacLeod, A., Ollerenshaw, A., Robinson, N., Wong, M., Thompson, H., & Doyle, R. (2024). Visualising Australasia's Soil (VAS): a novel soil research data federation. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Datta, D., Paul, M., Murshed, M., Teng, S.W. & Schmidtke, L. M. (2024). Transformer-guided noise detection and reconstruction in remote sensing data for enhanced soil organic carbon estimation. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Dzoma, B. & Wilhelm, N. (2024). More profitable crops on highly calcareous soils by improving early vigour and overcoming soil constraints. Agronomy Australia Conference, Albany Exhibition Centre, Albany, WA, Australia. 21-24 October 2024. <https://agronomyconference.com/wp-content/uploads/2024/12/1140-Brian-Dzoma-105.pdf>

Hardie, M., Edwards, S., Boucher, C., Gardner, D. & Jiang, C. (2024). Emerging technologies from UTAS and the Soil CRC. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Jiang, C., Hardie, M., West, D., Bai, Q. & Page, D. (2024). Advancing multi-depth soil moisture and hydraulic characteristics prediction with the EnKF-fsolve model for heterogeneous soils. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Kaur, H., Singh, G., Vinu, A., Ramadass, K., Yeasmin, M., Van Zwieten, L., Lamb, D., Panigrahi, P., Tavakkoli, E., & Zheng, B. (2025). Agriculture waste-derived biochar and clay composites as slow-release P fertilisers. CARBON 2025, The World Conference on Carbon, Palais du Grand Large, Saint Malo, France, 29 June - 4 July 2025. <https://carbon2025.exordo.com/programme/presentation/446>

Khan, M. S. A. (2024). Soil Health Chip: A cost-effective and portable device for precision agriculture. 2024 Royal Australian Chemical Institute (RACI) R&D Topics Conference in Analytical and Environmental Chemistry (AND1657), UTAS Hobart, TAS, Australia, 1-4 December 2024. <https://raci.org.au/events/event-description?CalendarEventKey=b756ba27-91ba-4c4d-aba4-018f03c6d04a&CommunityKey=3c814b0b-06a2-4338-ac06-018bda73dab8&Home=%2fevents-and-awards%2fevents>

Lai, Y. (2024). Simulating preferential flows and hydrophobicity of sandy soils in Western Australia using APSIM Next Generation. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Lang, S. J., Cavagnaro, T., Chittleborough, D., Wilhelm, N. & Tavakkoli, E. (2024). Ameliorating hardsetting sandy soils for cereal production. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Luke, H. & Evensen, E. (2025). Bridging disciplines for regenerative futures. International Association for Society and Natural Resources (IASNR) Conference 2025, University of British Columbia, Vancouver BC, Canada, 8-12 June 2025. <https://iasnr.org/assets/Uploads/Documents/Conference-Programs/2025-IASNR-Conference-Program-Vancouver-Canada.pdf>

Majid, N., Bahar, M.M., Harper, R., Megharaj, M. & Naidu, R. (2024). Remediation of hydrophobic soils using microbial treatment in conjunction with carrier biochar and clay. International Cleanup Conference, 10th International Contaminated Site Remediation Conference incorporating the 4th International PFAS Conference, Adelaide, SA, Australia, 15-19 September 2024. <https://airdrive.eventsair.com/eventsairaueprod/production-eventstudio-public/12132c8dcf9d451b8e70d247c26d3752>

Majid, N., Harper, R., Naidu, R. & Bahar, M. M. (2024). New insights into overcoming soil water repellency: a major tillage problem. 22nd International Soil Tillage Research Organisation (ISTRO) International Conference, Abstract #83, Page 160, Virginia Beach, VA, USA, 23-27 September 2024. https://www.aresc.vaes.vt.edu/content/dam/aresc_vaes_vt_edu/eastern-shore/istro-2024/abstract-book/AbstractBook_ISTRO2024.pdf

McGuinness, E., Gibson, A., Wells, N., Oakes, J. & Farrell, M. (2024). Subsoil organic carbon stocks in long-term grazing systems of Northeast NSW. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_885bc87253ba40dabae5e067908ca764.pdf

Morrison, M., McKenzie, K., Greig, J., Small, F., Nayeem, T., Frost, M., Pawsey, N. & Maraseni, T. (2025). Improving assurance schemes through the identification of core design features and options and the use of design thinking workshops involving agrifood value chain stakeholders. 69th Annual Conference of the Australasian Agricultural and Resource Economics Society (AARES) - Meeting the Challenges of Transition to a Sustainable Future, Brisbane, QLD, Australia, 11-14 February 2025. <https://www.aares.org.au/events/AARES-2025-Conference/>

Nahar, K. Rezaei Rashti, M., Van Zwieten, L., Tavakkoli, E., & Chen, C. (2024). Exploring soil resilience to pH changes in Australian agriculture through field surveys and meta-analysis. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_885bc87253ba40dabae5e067908ca764.pdf

Nodi, S. S., Paul, M., Robinson, N., Wang, L., & Rehman, S. U. (2024). Munsell soil colour prediction from the Munsell Soil Colour Book using android mobile application. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Pawsey, N. (2025). Buried concerns: The overlooked importance of soil in environmental reporting. 15th Spanish Conference on Social and Environmental Accounting Research, Faculty of Economics and Business, Autonomous University of Madrid, Madrid, Spain, 5-6 June 2025. <https://eventos.uam.es/112070/detail/15th-spanish-conference-on-social-and-environmental-accounting-research.html>

Pawsey, N., Ascui, F. & Frost, M. (2024). Opportunities to enhance corporate reporting on soil health and risks. 9th Italian Conference on Social and Environmental Accounting Research, Center for Agricultural and Rural Development (CSEAR Italy 2024), Piacenza, Italy, 16-17 September 2024. <https://csear.co.uk/event/9th-csear-italy-conference-4th-csear-doctoral-colloquium/>

Pawsey, N., Allan, C., Ascui, F., Frost, M., Wong, A. & Abbasi, S. (2024). A systematic review of the economic viability of soil stewardship. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Pearce, A. & Wilhelm, N. (2024). Correcting iron deficiency in broad beans growing on highly calcareous clay loams. Agronomy Australia Conference, Albany Exhibition Centre, Albany, WA, Australia. 21-24 October 2024. <https://agronomyconference.com/5837/>

Robinson, N., Ollerenshaw, A., Chadha, A. & Dahlhaus, P. (2024). Soil indicator choices in Australian farming systems. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Weir, P. (2024). Better understanding of within-field spatial variability of soil water. Joint NZSSS and SSA Conference 2024 – Weaving Soil Science Across Cultures & Environments, Energy Events Centre, Rotorua, New Zealand, 2-5 December 2024. https://www.soilscience.org.nz/_files/ugd/623971_ff817efc76004bf5be845cd12ea6009a.pdf

Wirf, L., Allan, C., Luke, H. & Kilham, S. (2024). A picture is worth a thousand words: How images on agriculture organisation websites construct gender- and why it matters. Australasian Agri-food Research Network Conference 2024, Twin Towns Conference and Function Centre, Tweed Heads, NSW, Australia, 2-6 December 2024. <https://afrn.co/wp-content/uploads/2025/02/AFRN-Conference-Program-2024.pdf>



CRC for High Performance Soils Limited

ABN 63 618 897 224

Level 1 IDC Building
The University of Newcastle
University Drive, Callaghan NSW 2308

www.soilcrc.com.au

E enquiries@soilcrc.com.au

T +61 2 4921 5473



Australian Government
Department of Industry,
Science and Resources

**Cooperative Research
Centres Program**