Federation University | Centre for eResearch and Digital Innovation

CeRDI Annual Report 2020

Acknowledgement of Country

Federation University Australia acknowledges the Custodians of the lands and waters where our campuses are located and recognises their continuing responsibilities to care for country at these sites of teaching and learning. We pay our respects to Elders past and present and extend our respects to all Aboriginal and Torres Strait Islander First Nations peoples.

The Aboriginal Traditional Custodians of the lands and waters where our campuses, centres and field stations are located include:

BALLARAT | Wadawurrung

BERWICK | Boonwurrung

BRISBANE | Turrbal and Jagera

EUSTON STATION | Tatti Tatti

GIPPSLAND | Gunai Kurnai

NANYA STATION | Mutthi Mutthi and Barkindji

WIMMERA | Wotjobaluk, Jaadwa, Jadawadjali, Wergaia, Jupagulk

For further details about CeRDI's diverse portfolio of research please visit our website: **www.cerdi.edu.au**

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Contents

Foreword

Professor Chris Hutchison, Deputy Vice-Chancellor (Research and Innovation)

Federation University's Strategic Plan (2021-2025) sets out a vision for the next five years, providing direction for the University across its teaching and research endeavours. CeRDI will play a key role in this vision for research; complementing the University's directions through the continuation and extension of research activities that generate significant outputs that are nationally and internationally recognised.

During 2020, CeRDI has embraced many opportunities, enabling it to foster partnerships that support the strategic vision for the University. The continuation of established partnerships is an important feature of the work that CeRDI undertakes.

The research that CeRDI conducts incorporates and supports the wider community and builds the provision of information and technology for greater benefit. The projects in this report exemplify the importance of partnerships to CeRDI and its investment in the ongoing development of these successful networks and programs.

This report offers a snapshot of the many projects that CeRDI is successfully leading and collaborating on. It reflects the hard work and vision of its Director Assoc Prof Helen Thompson and the CeRDI team of researchers, technical and administrative staff and HDR candidates. This winning combination makes CeRDI one of our most successful research Centres at the University and I look forward to its continued growth and success in the years to come.

Introduction

Associate Professor
Helen Thompson,
CeRDI Director

CeRDI is renowned for its engagement with external organisations, the impact of its research and for its track record and leadership in data interoperability and data federation.

Research efforts during 2020 have been directed towards leading digital transformation and practice change through collaboration with industry, government, academic and community organisations.

Working with data is central to the research that CeRDI conducts and is reflected in the projects exemplified in this report. Data capture and data sharing through online platforms provides the foundation to enable discoveries that can build new knowledge and improve decision making to enhance current practices.

For CeRDI, data discoveries are facilitated through the data platforms and portals that we develop in collaboration with a host of partners, and in accessing this data to research and improve outcomes. Across the key themes of Agriculture, the Natural Environment, Health and Wellbeing and others, CeRDI is contributing important insights informed by data, and the discoveries that can be achieved through data federation and dissemination.

Although 2020 has presented many challenges with the COVID-19 pandemic, for the CeRDI team it has also provided many opportunities that have enabled the fostering of partnerships and the completion of projects across all our research themes.

I invite you to learn more about CeRDI through the stories and projects compiled in this annual report and to share in and celebrate our achievements, in collaboration with our partners, during 2020.

About CeRDI

Overview

The Centre for eResearch and Digital Innovation (CeRDI) at Federation University Australia located within the Office of the Deputy Vice-Chancellor (Research and Innovation) and based at the Ballarat Technology Park, Mt Helen.

CeRDI's multidisciplinary research capabilities distinguish it from traditional research centres. This ensures that the research undertaken has impact across a broad discipline base and in each of the six research themes.

CeRDI has a long and established record and reputation for achieving successful outcomes and is committed to building capacity and engagement with its collaborators. This ensures the application and uptake of its technologies and the research benefits support our project and funding partners, industry and the broader community.

Significant advances expanding engagement in spatial information systems, visualisation, knowledge management and data interoperability through the work of CeRDI. CeRDI responds to and anticipates new technology directions and opportunities based on insights from research and partner engagement. These innovations generate beneficial outcomes and attract sustained research investment.

CeRDI's research approach is characterised by the following attributes:

- **Partner engagement** – listening skills and the ability to translate information from partners into research projects with outcomes that stakeholder's value. CeRDI has a reputation for consistency, reliability, timeliness, credibility and excellence.
- **Fostering long-term partnerships** – sustained beyond the period of initial grant funding (many partnerships have continued for more than 10 years) and undertaking practical and applied research that deliver on outcomes.
- **A multidisciplinary team** – comprised of researchers with specific discipline expertise, technical and support staff and HDR candidates drawn from within the research centre and elsewhere in Federation University. These are essential foundations for innovation, knowledge and technology transfer.
- **A diverse portfolio** – stretching across a range of disciplines, with a multiplicity of organisations contributing to overall financial sustainability.
- **Prioritising a high level of co-creation** – through close linkages and engagement with staff from partner organisations including researchers, government, industry and community, which catalyses knowledge mobilisation and ensures beneficial outcomes for partner organisations.
- **Continuous innovation** – in data federation, knowledge management, web publishing, spatial mapping, data visualisation and decision support systems.
- **A leader in eResearch and digital innovation** – adding value to areas of research strength at Federation University aligned with the national eResearch framework and the National Strategic Research Priorities.

CeRDI Team

CeRDI employs 28 staff (full-time; part-time; casual) with 19 staff in the research team, seven in the technical team and two project management and administration. CeRDI has nine HDR (PhD) candidates.

eResearch

eResearch is the application of information technologies to support existing and new forms of research. At CeRDI eResearch is exemplified within the following four methods:

- **Applied** – research focused on collaborative design that results in co-developed solutions that meet specific real-world priorities for our research investors, stakeholders and communities.
- **Impactful** – research that creates novel and disrupting technologies that enhance industry, sector, and community practices; improve digital literacy among researchers and industry practitioners; and influences social change through implementing data and information democracies.
- **Multidisciplinary and cross-disciplinary** – in that CeRDI contributes to a range of Field of Research (FoR) codes (information and computing sciences; physical geography and environmental geoscience; earth sciences; human movement and sport science and historical studies) and collaborates with researchers across almost all Schools across Federation University.
- **Collegiate, collaborative and inclusive** – when leading and participating in a range of research projects at the international, national and regional scale.

Research themes and activities

At CeRDI, eResearch and digital innovation has focussed on the development of interoperable spatial knowledge systems that meet the needs of our research investors across a range of diverse disciplines.

Most of these systems are collaboratively designed and developed to federate qualitative and quantitative data from disparate sources, both in the public and private sectors. The data federations are almost always provisioned as customised web-based portals that are used for data discovery, dynamic modelling and visualisation, decision support, and knowledge dissemination.

The demand for these bespoke knowledge systems has driven significant and growing investment in our research that has clustered around six core themes:

- **Natural Environment**, including land, water and biosphere, with research investment in catchment management, citizen science, community-based monitoring, protection and conservation of threatened species, implementing environmental sensor technologies, environmental modelling and decision support systems, and monitoring, evaluation, reporting and improvement (MERI).
- **Agriculture**, mostly focused on broad-acre farming, with research investment in precision agriculture, food agility, soil performance and health, on-farm data aggregation and visualisation (public-private data federations), farm decision support systems, on-farm sensors and Internet of Things (IoT) technologies, remote and proximal sensing technologies, cropping trials, grains trials research, and real-time soil moisture sensing and interpolation.
- **Hazard Planning and Resilience**, including emergency management planning and disaster recovery, with research investment in emergency services, community-based emergency management, fire, flood, landslides, coastal inundation and erosion, community engagement tools, community monitoring tools, strategic planning for emergencies and natural disasters, and planning and preparedness for climate change.
- **Health and Wellbeing**, including social justice and regional health challenges, with investment in spatial mapping of sports and recreational activities and services, diagnostic tools to assist with dementia referrals, collaboration and evaluation on health justice partnerships, interventions for youth alcohol consumption, family and domestic violence, and sport and leisure injury epidemiology.
- **Heritage and Culture**, including Historic Urban Landscapes (HUL) and Aboriginal land management, with investment in urban planning, social perceptions, landscape amenity, tourism, tools to support indigenous cultural assets management and mapping indigenous heroism, and digitising local history associated with World War One and World War Two.
- **Regional Development**, mainly focused on supporting regional communities in strategic planning, with investment in digital strategies and improving digital literacy, fostering smart cities, business accelerators, portals to support strategic and statutory planning in municipalities, and information portals to support regional communities.

CeRDI Technological Approach

CeRDI's Capability: Interoperability

The majority of CeRDI's eResearch is invested in the development of spatial data portals.

These portals address the increasing problems associated with the sheer range of information sources and volume of data that is now available (i.e. in the era of big data). In Australia, for example, information and data on agricultural soils is distributed via dozens of web-portals, web-based geographic information system (GIS) tools, password-protected portals, cloud storage, portable storage devices, hardcopy maps, theses, reports, newsletters, documents, videos and podcasts. Outside of the research community, however, this vast source of data is largely ignored, as few people have the time or the skills to consolidate available data.

To address these concerns, spatial data infrastructure (SDI) has been developed and deployed to federate data from disparate database sources into a single web portal, thereby making data more easily discoverable. Globally, the systems developed by Natural Resource Canada provided the initial exemplars that were developed using open geospatial standards and technologies. Other examples include the European Commission's INSPIRE network, the New Zealand SMART system, and those developed by the United States Geological Survey, the French Bureau de Recherche Géologiques et Minières (BRGM), Australia's CSIRO, and the Australian Bureau of Meteorology (BOM).

CeRDI actively collaborates with these leading organisations by sharing open source technologies and developing open standards. Seamless international information exchange of complex domain data, such as groundwater or soil data, relies on agreed formats, communication protocols and schemas for serving, querying and consuming data, along with agreed content (known as semantic interoperability).

CeRDI's Capability: Systems Architecture

The spatial data infrastructure (SDI) deployed by CeRDI was initially developed by CSIRO, and is known as the Spatial Information Services Stack (SISS).

At the core of the SISS is the open source spatial data engines Mapserver (www.mapserver.org) and Geoserver (geoserver.org), which are used for the geospatial processing and service delivery using Open Geospatial Consortium (www.opengeospatial.org) standards. Vector data are commonly stored within a MySQL or PostGIS database, and raster data are dynamically processed from their native format. To deliver complex web feature services (WFS), the Geoserver app-schema extension has been deployed. Geonetwork (geonetwork-opensource.org) is used as the public-facing metadata catalogue for the portals.

The general systems architecture and data flow from custodians to end users is illustrated in Figure 1.

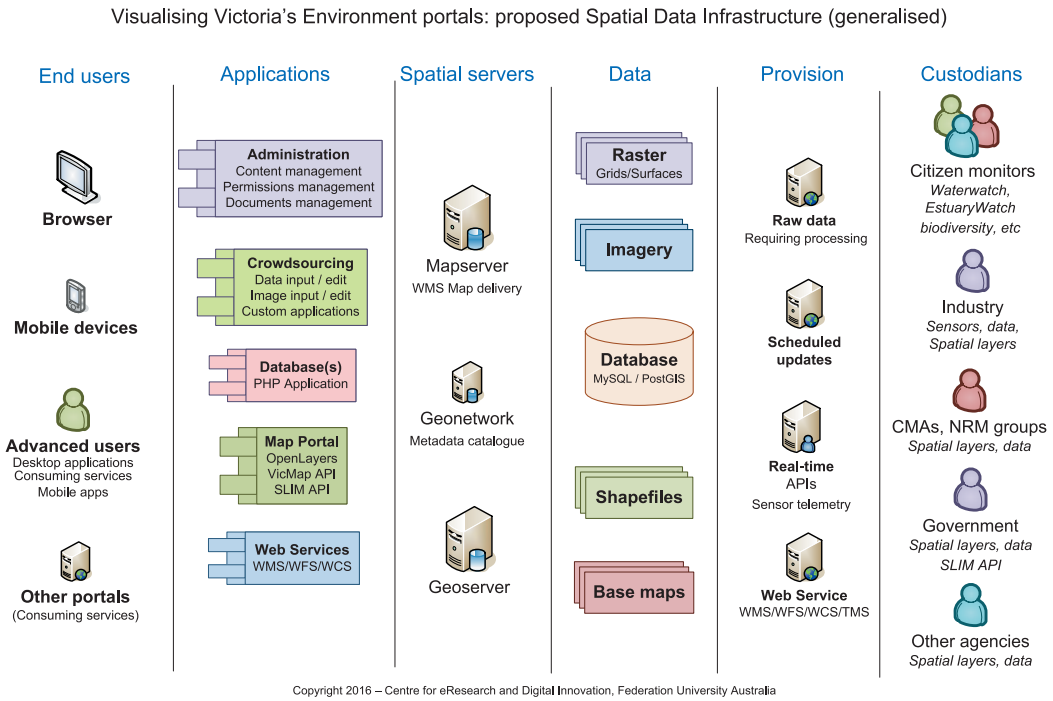


FIGURE 1. CERDI'S GENERAL SYSTEMS ARCHITECTURE AND DATA FLOW FROM CUSTODIANS TO END USERS (SOURCE: DAHLHAUS AND THOMPSON, 2016).

Key components of the system include:

- The data resides with the data managers (ensuring currency and validity).
- They are intuitive to use (similar to Google Maps).
- All forms of data are included (vector, raster, text and multimedia).
- Data downloads are allowed (subject to data custodian's consent).
- Spatial data links to original source (documents and images).
- Spatial data links to real time data (data loggers, webcams).
- They are capable of analysing the interoperable data on the fly.
- Interactive 3D visualisations can be created for user-selected scenes.
- Users can add, edit or update data (subject to quality assurance and quality control).
- The spatial data and models are credible to the user.

The key principles underlying all technical innovation and development at CeRDI include:

- ensuring end-user tools and applications are fast, intuitive and easy-to-use,
- making sure that applications work seamlessly across a variety of platforms, operating systems and browsers to the extent possible,
- use of open-source and standards compliant software and technologies, wherever possible,
- building upon existing collaborative software initiatives and contributing enhancements/tools back to the community,
- ensuring the flexibility of the developed system to consume data from a variety of sources so as not to interfere with existing provider work practices, and
- use of software based in the cloud: no end-user requirement for software, updates, computation power or plug-ins.

The CeRDI technical team applies best practices for web development to ensure systems are responsive and accessible to the needs of users. Members of the CeRDI technical team have relevant qualifications and capabilities as well as extensive training and industry experience to ensure optimal project outputs. This enables delivery of scalable and customised applications to meet the unique requirements of various project partners.

CeRDI adopts an agile path for software and spatial knowledge systems development. Rapid prototypes of products are developed in conjunction with project partners, stakeholders and researchers to ensure that technical requirements are met at each stage of development.

CeRDI
Research Projects

AGRICULTURE

Visualising Australasia's Soils

Extensive research engagement on the *Visualising Australasia's Soils (VAS): A Soil CRC cloud based research data federation* culminated in the launch of the pilot data portal and release of the Governance and Data Stewardship guidelines.

VAS provides research collaborators and the general public an opportunity to examine and explore comprehensive soils data, most of which comprises public sector data that is generally brought in 'on the fly'. The pilot data portal offers initial insights into capabilities of the portal, with work still to be completed on the design of portal tools, to be developed in consultation with end users.

VAS is a collaboration with 20 industry and agency partners which is being led by Associate Professor Peter Dahlhaus and other members from the CeRDI team. This research will deliver an interoperable spatial knowledge system to provide Soil CRC participants and the broader agricultural industry with access to data, information and knowledge on Australasian soils. Established CeRDI technologies are being leveraged to federate data from disparate sources in both the public and private sector, making agriculture data more Findable, Accessible, Interoperable and Reusable (FAIR).

The full VAS benefits are yet to be realised. Mapping soil data from Australia and New Zealand is the ambitious target set for this project. Federating soil data in the one location is unique, offering first time access to data from Australian agricultural industry. The benefits of new knowledge and understanding gained from enhanced agricultural data availability, together with available landscape data such as rainfall, terrain and ground water, will be to inform decision-making associated with future farming practices and improved land performance. The potential use for the data could further inform farming yields and make farm production more sustainable. It is also anticipated that VAS will support the understanding of the cause-and-effect relationships across farming landscapes.

A report was prepared to address guidelines on governance and data stewardship. The preferred model under which VAS will operate, will use federated data, where data control and management is retained by the data custodians. Such arrangements overcome the barriers that are often experienced when sharing data. The VAS portal therefore uses a cloud-based data service that complies with international data standards. The guidelines will be shared and are accessible through the Soil CRC website.

A cohort of CeRDI PhD candidates are exploring the research potential associated with VAS. The world-class technology capabilities of the project together with dedicated research projects aligned with understanding the data will ensure data access and data discoveries are achieved concurrently.

PROJECT PARTNERS

Cooperative Research Centre for High Performance Soils (Project funder)

Birchip Cropping Group

Burdekin Productivity Services

Central West Farming Systems Inc.

Gillamii Centre

Herbert Cane Productivity Services Ltd

Holbrook Landcare Network

Liebe Group

North Central Catchment Management Authority

Nutrien (formerly Landmark)

Riverine Plains Inc.

Southern Farming Systems

University of Southern Queensland

University of Tasmania

Western Australia No Till Farmers Association

West Midlands Group

Wimmera Catchment Management Authority

Website:
https://data.soilcrc.com.au/map/about

For more information:
www.cerdi.edu.au/VisualisingAustralasiasSoils

AGRICULTURE

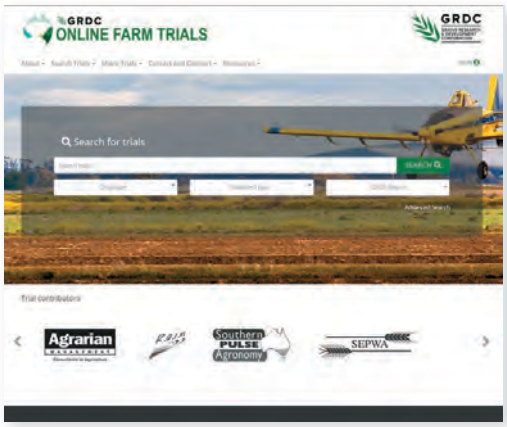
Online Farm Trails

Online Farm Trials (OFT) is a long-term, collaborative project involving CeRDI and the Grains Research and Development Corporation (GRDC).

OFT commenced in 2015 and involves the digital transformation of trial research data and information from Australia's grains industry. It offers advanced spatial mapping and filtering systems for accessing current and legacy data. The trials data available on the portal have been supplied by stakeholders, including grower and farming systems groups, government researchers, universities and private industry across Australia. Currently there are over 15,000 trials available on the site. This provides access to a public repository of varied trials and data from multiple sources which can then be used to assist with on-farm decision-making.

The OFT portal is continually evolving, and new data is regularly uploaded to ensure increased breadth and currency of available data and information. An expert advisory group provides governance to OFT with the research and technology developments undertaken by CeRDI under the leadership of senior research fellow Dr Nathan Robinson.

Data collection to support a third wave of impact research for OFT commenced in late 2020. Survey and interview data will be collected to assess the impact of technology in supporting decision making and practice change. Impact research has been undertaken with OFT on two previous occasions to provide and extend the insights about how web portals, such as OFT, have been being applied and used. The research will provide extended insights about the role of technology on users of the portal; their knowledge, decision making and work practices.



PROJECT PARTNERS

Grains Research and Development Corporation
Ag Excellence Alliance (South Australia)
Birchip Cropping Group
Grower Group Alliance
International Plant Nutrition Institute
Liebe Group
Nicon Rural Services
Northern Grower Alliance
Southern Farming Systems
Victorian Grower Group Alliance

Website: https://farmtrials.com.au

Food Agility Cooperative Research Centre

AGRICULTURE

In 2020, CeRDI Senior Research Fellow Dr Birgita Hansen commenced in the role of Better Data for Better Decisions Constellation Leader with the Food Agility Cooperative Research Centre (CRC). The constellation is a Food Agility program of research that aims to improve the collection, management, sharing and use of farm data in the agri-food sector.

The Better Data for Better Decisions Constellation is underpinned by the FAIR (findable, accessible, interoperable, reusable) principles for data. This sets an ambitious but exciting target for the constellation: namely, to establish FAIR data projects in the agriculture sector, improve digital adoption and data sharing, while meeting Food Agility's objective of developing digital innovations that have economic benefits for the sector.

A key part of Birgita's role is to establish new collaborative projects and partnerships between Food Agility, the research sector, government and industry. Industry partners include those already involved in Food Agility, existing CeRDI partnerships, and emerging new partners in the agtech sector. Food Agility projects are designed using an innovative agile research model model to deliver the impact that industry needs. This involves generally starting with small 'sprint' projects, then using these as a foundation for larger programmatic research programs. All research projects require at least three partners: an agri-food industry partner, a technology partner, and a research partner, with Food Agility co-investing with the other project partners.

The Better Data for Better Decisions Constellation kicks off with its first Food Agility project Decision Wizard, which takes desktop based tools for supporting farmer decision making and converts these to interactive online tools that capitalise on interoperable data exchange to pre-populate data fields. The Decision Wizard project is a partnership with Nicon Rural, Marcus Oldham College and Southern Farming Systems. A number of Federation Higher Degree by Research projects are also linked to the data constellation.

PROJECT PARTNERS

Food Agility CRC

Precision Agriculture

Southern Farming Systems

Riverine Plains

Nicon Rural

Marcus Oldham College

For further information:

www.foodagility.com/research/better-data-for-better-decisions-constellation

www.foodagility.com/projects/decision-wizard

AGRICULTURE

Agriculture Research Federation

Federation University Australia and the Australian Research Data Commons (ARDC) announced a new project that will accelerate research innovation and enhance the Agricultural Research Federation (AgReFed) platform.

The AgReFed platform supports collaboration and innovative insights in agricultural research, development and policy by improving the discoverability of trusted, reusable and analysis-ready agricultural research data across Australia.

This is one of 16 new collaborative projects in the ARDC 2020 Platforms program aiming to facilitate and encourage radical changes in the way research is conducted, and dramatically increase the speed of research.

CeRDI will lead the new project to increase the platform's ability to adapt to the way agricultural researchers collect, describe, and disseminate their research findings. The project will address some of the current challenges facing agricultural researchers, who perform data management and analysis on desktop computers. Many have limited access to platforms, workflows and analysis tools designed for agricultural research.

The changes envisioned for the project will allow researchers to better access trusted, reusable agricultural data. This will facilitate data reuse and cross-discipline collaborations for novel research insights and practical applications in policy, reporting and on-ground decision making.

CeRDI Director and AgReFed Council Chair, Associate Professor Helen Thompson, commented that the project and associated funding will enable AgReFed to accelerate its activities towards providing access to agricultural research data from across Australia. Helen also noted the important collaborations for the project stating, "We are delighted that Federation University, Queensland Cyber Infrastructure Foundation (EcoCommons), Sydney Informatics Hubs (University of Sydney) and international partners will collaborate on the AgReFed platform technologies".

PROJECT PARTNERS

National Research Infrastructure Strategy
Australian Research Data Commons
The University of Sydney
Queensland Cyber Infrastructure Foundation
Grains Research and Development Corporation
Atlas of Living Australia
Australian Plant Phenomics Facility
CSIRO
Geoscience Australia
NSW Department of Primary Industries
TERN, The University of Queensland
The University of Adelaide
The University of Western Australia
University of New England
University of Southern Queensland
Western Australia Department of Primary Industries and Regional Development
Earlham Institute
EcoCommons, Griffith University
Food and Agriculture Organization of the United Nations
Griffith University
Macquarie University

Website: www.agrefed.org.au/

AGRICULTURE

Southern Farming Systems – National Landcare Program

Southern Farming Systems (SFS) received funding from the Australian Government's National Landcare Program for the project 'Building the resilience and profitability of cropping and grazing farmers in the high rainfall zone of Southern Australia'.

Commencing in 2018, this four-year project will increase the ability for farmers and agronomists to make better on-farm management decisions.

This project is coordinated by Southern Farming Systems and involves two distinct components. The first addresses soil acidification, with the overall aim of improving the precision (timing, rate, location) for when lime is applied on cropping and grazing farms and to develop cost effective ways of rectifying subsoil acidity. This component of the project will unlock value by actively engaging all parties involved in the lime supply chain.

The second component focuses on resilient farm businesses and strengthening farm decisions by combining the highly successful Grain & Graze decision procedures with four key pieces of vital real-time information – soil water, pasture availability, commodity prices and climate data. A consolidated data and decision support platform is aimed at building skills and confidence in farmers (especially women farmers and young farmers) and will be a key outcome associated with this project.

For further information:
www.cerdi.edu.au/NLPSmartFarming

PROJECT PARTNERS

Australian Government – National Landcare Program

Southern Farming Systems

McKillop Farm Management Group Inc

Agriculture Kangaroo Island

Department of Jobs, Precincts and Regions, Victorian Government

Agriculture Victoria

Precision Agriculture

Glenelg Hopkins Catchment Management Authority

Victorian Lime Producers Association

Australian Fertiliser Services Association

Managing and enabling soil data

AGRICULTURE

Funding has been awarded to develop a comprehensive online platform providing Australian farmers with access to the latest research and information about soil.

The project, 'Improved soil data management', will be led by Federation University (CeRDI) and delivered through the Soil Cooperative Research Centre (Soil CRC), is a collaboration between universities, state government agencies, grower groups and industry from across Australia. Project partners include Charles Sturt University, Manaaki Whenua Landcare Research New Zealand, NSW Department of Primary Industries and The University of Tasmania.

Until now, consolidated information about Australian soils has not been readily available. Soil data is disparate and is not easily or widely accessible. This has restricted a farmer's ability to access soil research that could benefit them and the industry.

The soil data project will consolidate information on soil nutrition, biology, moisture and physical and chemical constraints. Making this data available from a dedicated, online website is expected to facilitate better decisions about resource management that will boost productivity and profit. Stakeholders expected to benefit from this project include farmers, grower groups, government departments, universities and industry.

In addition, the project will incorporate an educational component. Structured training will be offered to Soil CRC members, partners and those collecting and using soil data in data management and practices to enable more efficient collection and sharing soil data. There is also the potential for extending work on the development of more support tools with future applications.

Project leader and CeRDI's Dr Nathan Robinson commented on that the accessibility of data would ultimately improve productivity and profitability for farmers and growers alike. "There is a wealth of information about soil that can help governments, grower groups and farmers to make better decisions about how they manage their resources, but until now, it has not been available in one place." Nathan referred to the unique benefits of this project in finding new solutions in soil to aid the industry saying, "Through this project we would like to find a solution to help manage soil data to make research results available to partners in the Soil CRC, which will ultimately result in improved soil quality and performance in the longer term".

Chief Executive Officer of the Soil CRC, Dr Michael Crawford, welcomed the project, highlighting it as a fundamental project integral to the success of the Soil CRC. "We have now allocated over $19 million for soil R&D projects, so it is important that we have an efficient and effective mechanism for managing the data that is generated through this investment and making it available to participants".

The Soil CRC is anticipating much interest in the project and it is expected that the project will have long-term research benefits for the agricultural industry.

PROJECT PARTNERS

Manaaki Whenua Landcare Research

NSW Department of Primary Industries

Charles Sturt University

University of Tasmania

Website: https://soilcrc.com.au/current-projects/#project_2_2_005

AGRICULTURE

Hyper Yielding Crops

A major agriculture initiative has commenced with the aim of maximising cropping yields in high rainfall areas.

Funded by the Grains Research and Development Corporation (GRDC) under the leadership of the Foundation for Arable Research (FAR), the Hyper Yielding Crops project will inform the setting of attainable grain yield targets in regions where there is the potential for high yield cropping.

Conducted over the next five years, the project will establish five GRDC Centres of Excellence for research, development and extension hubs. These will be in Western Australia, South Australia, Victoria, Tasmania and New South Wales. A series of Focus Farms and Award sites associated with each Centre of Excellence will be established for demonstration, comparison, and extension of crop management practices for optimising yield.

CeRDI is developing the online data management and reporting platform for the Focus Farms and Award sites in partnership with key collaborators including FAR, Techcrop, and four farming groups: Southern Farming Systems (in Tasmania and Victoria), MacKillop Farm Management Group (in South Australia), Riverine Plains Inc. (in New South Wales), and Stirlings to Coast Farmers (in Western Australia).

The online platform, which is currently under development, includes a customised web interface to capture, manage and report on the paddock data for the project. Data uploads to the platform will be supplied by participating farms for the cropping sites. The website will incorporate tools and functionality, including an intuitive, user-friendly dashboard to support project management and monitoring of data. Wide-ranging data will be collected from the sites and uploaded to the online platform. These data will include paddock descriptions, crop types, management outputs, soil information, climate observations, crop outcomes, and crop outputs. Using the data captured through the platform, annual paddock information summary and performance reports will be generated by the system and provided to growers participating in the project.

Development of the web interface is being undertaken by CeRDI's Paul Feely and Rob Milne. The platform will support the collection and management of data over the current, and the following four grower seasons.

PROJECT PARTNERS

GRDC

Field Applied Research Australia

Techcrop

Southern Farming Systems
(in Tasmania and Victoria)

MacKillop Farm Management Group

Riverine Plains Inc.

Stirlings to Coast Farmers (Western Australia).

Website:
www.cerdi.edu.au/HyperYieldingCrops

The Yarra Catchment Atlas

NATURAL ENVIRONMENT

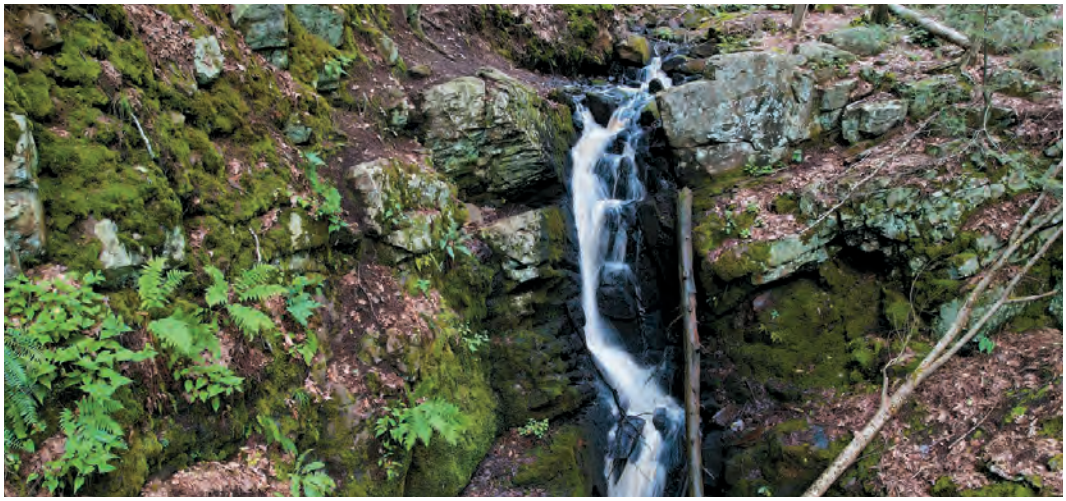
The Yarra Catchment Atlas is a spatial information portal featuring biodiversity, environmental and cultural information for the Yarra Catchment.

CeRDI has partnered with the Yarra Riverkeeper Association (YRA) on this project, having completed substantial work on the online information portal in 2019. During 2020, upgrades were made to support greater community reporting of pollution data.

The portal now enables the recording of observations about polystyrene pollution (https://map.yarraatlas.org.au/sights), including a new polystyrene rating tool that allows recording of polystyrene litter hotspots, and provides an additional mechanism for polystyrene pollution data to be documented. Upon approval by the YRA, these observations are documented and visualised in the online mapping portal: https://map.yarraatlas.org.au/?view=16268_3c7ff35

New spatial layers including polystyrene field inspection data sets have also been added into Yarra Catchment Atlas. These geometric features are styled based on their hotspot ratings: Rating 1 means no polystyrene present and Rating 5 represents a very significant amount of polystyrene present. This enables Yarra Catchment Atlas users to identify hotspots where polystyrene pollution has been recorded: https://map.yarraatlas.org.au/?view=16269_072db31

The Yarra Catchment Atlas was first developed to federate a range of relevant datasets to the Yarra River catchment into a publicly-accessible interactive mapping portal. The overall aims of the portal were to gain better insight into biological and ecological systems in the Yarra Catchment and how they influence dynamics in Port Phillip Bay; and improve appreciation and understanding of the Yarra Catchment and Bay. The recent upgrades to the portal, overseen by CeRDI's Dr Birgita Hansen and implemented by Sudeera Abeywickrema, have furthered these aims, ensuring greater links between the community and their local river and waterway environments and protecting the regional ecology.



PROJECT PARTNERS

Yarra RiverKeeper Association

Department of Environment, Land, Water and Planning Victorian Government

Port Phillip Bay Fund

Website:
www.cerdi.edu.au/YarraCatchmentAtlas

NATURAL ENVIRONMENT

LitterWatch Victoria

A successful collaboration between Federation University's Centre for eResearch and Digital Innovation (CeRDI) and the Department of Environment, Land, Water and Planning (DELWP) has culminated in the development and launch of LitterWatch Victoria.

LitterWatch is an online portal that collates public, state-wide datasets of litter in Victoria that can be easily visualised and is readily used for reporting, planning, policy making and engagement. The project is a direct response to the growing challenges of litter and plastic pollution that communities are experiencing.

The management of litter is a strategic priority under the Port Phillip Bay Environment Management Plan, with litter clean-up estimated to cost over $94 million annually. Since 2017, the Port Phillip Bay fund has invested over $2.7 million in litter monitoring. The online portal was designed and created to assist in identifying the different monitoring programs, and to secure the collated data. Litterwatch is intended to support the development of a litter baseline, and other activities under the Port Phillip Bay Environmental Management Plan, including plastic pollution policies. The portal has reporting functionality and program analysis, which is enabling data on litter hotspots across Port Phillip Bay to be accessed by the general public.

The development of LitterWatch Victoria involved extensive baseline research examining litter monitoring methods and litter pollution data for the Port Phillip region. A feature of the project has been the development of a standardised litter monitoring database and online spatial information system, which includes the federation of community and agency litter monitoring data. It also included an honours research project on litter monitoring methods, conducted by Hamish McDonough and completed in 2019.

LitterWatch Victoria was led by CeRDI's Dr Birgita Hansen with significant input from members from the CeRDI's research support and technical teams, particularly Scott Limmer, Andrew Macleod, Sudeera Abeywickrema and Dr Angela Neyland. The technical team, in partnership with DELWP and representatives of key community litter monitoring groups, developed an online spatial 'litter data portal' that is designed to capture litter data in a standardised and reportable format.

In commenting on the development and design of the project Birgita said, "A huge amount of work has gone into developing this system, and ensuring we accommodate different end user needs. Through ongoing liaison with a range of stakeholders, particularly our key community partners Beach Patrol, Bellarine Catchment Network and Port Phillip EcoCentre, we have designed a system that is intended to allow a range of different litter data collection techniques while still enabling standardisation across datasets".

This project has also involved partnerships with Sustainability Victoria, Bellarine Catchment Network, Beach Patrol, Love Our Street, and the Port Phillip EcoCentre. The CeRDI team would like to thank everyone who has helped with the co-development, testing and feedback.

PROJECT PARTNERS

Department of Environment, Land, Water and Planning Victorian Government

Sustainability Victoria

Bellarine Catchment Network

Beach Patrol

Love Our Street

Port Phillip EcoCentre

Website: www.litterwatchvictoria.org.au

NATURAL ENVIRONMENT

Visualising Victoria's Groundwater

CeRDI's award-winning project Visualising Victoria's Groundwater (VVG) has benefitted from updated data sharing arrangements with two of its primary custodians. The updates provide more timely and integrated groundwater data for the state.

These latest advances have implications for the VVG application broadly, while providing a use-case that will inform the important work that CeRDI is contributing to the Second Environmental Linked Features Interoperability Experiment (SELFIE) as a collaborative and contributing member of Open Geospatial Consortium (OGC).

VVG was launched in 2012 to provide easy access to all of the groundwater bore data for Victoria. The portal directly links the repositories of data that are managed by various government departments, agencies and research institutions. VVG provides access to data that is available for display as bore holes on a map, with links to the individual data for each bore. The benefit for water managers and groundwater users is easy access to current data that can assist in the consumptive use and environmental water flows.

The latest developments for VVG further expand the value of the portal, for contributors and end-users. A new application programming interface (API) deployed by GeoScience Victoria in collaboration with CeRDI will assist in delivering the Geological Exploration and Development Information System (GEDIS) data on borehole logs in an interoperable format. This will allow GEDIS information to be more closely integrated into VVG and potentially enable multiple sources of information on the same borehole to be combined.

Another development for VVG is the groundwater data extract for the Victorian Water Measurement Information System (WMIS), which is managed by the Department of Environment, Land, Water and Planning (DELWP). A new extract format and automated transfer to the VVG server ensures more regular updates for this major data source. The new extract provided by WMIS will streamline processes, as well as providing access to new, telemetered data.

The CeRDI team, including Andrew MacLeod, together with project leader Associate Professor Peter Dahlhaus and Bruce Simons have long anticipated and campaigned for the data sharing approaches now adopted by DELWP and GeoScience Victoria. All VVG end users will benefit from the latest updates which will ensure greater efficiency for accessibility, usability and currency of public data for industry and community decision making.

Furthermore, the latest updates are informing CeRDI's contribution and use case for SELFIE by enabling real-world testing on specific resource models using recognised best practices and OGC standards for a wide range of participant-provided, domain-specific use cases. The work that CeRDI and other Open Goespatial Consortium members are developing for SELFIE will provide a use-case across a range of programs and applications that will be a value-add for the industry.

PROJECT PARTNERS

Department of Economic Development, Jobs, Transport and Resources Victorian Government

Australian National University

Southern Rural Water

Victorian Department of State Development, Business and Innovation

Victorian eResearch Strategic Initiative (VeRSI)

CSIRO

Goulburn Murray Water

Thiess Services Pty Ltd

Queensland University of Technology

Natural Resources Canada

Senversa Pty Ltd

Cooperative Research Centre for Spatial Information (CRCSI)

Visualising Victoria's Groundwater:
www.vvg.org.au

NATURAL ENVIRONMENT

Zoos Victoria Moth Tracker

The Bogong Moth Tracker, which is hosted on the State Wide Flora and Fauna Teams (SWIFFT) website, is an online application that enables members of the public to upload sightings of the bogong moth during their seasonal, spring migration from Queensland, New South Wales and western Victoria to the alpine regions of Victoria.

Moth sightings inform research, providing researchers with data that can increase the understanding of the moth's migration. In turn, this can assist in identifying factors, such as the availability of food for the possums. The project is a collaboration between CeRDI and Zoos Victoria.

Bogong Moths are an essential food source for the Mountain Pygmy-possum and reduced food availability is thought to be contributing to the declining population of Mountain Pygmy-possums. The possum is currently listed as 'Endangered' under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. New knowledge from the Tracker will be used to inform decision making about future conservation and recovery efforts. This small marsupial, which is native to south-eastern Victoria, has been included in Zoos Victoria conservation program to support local wildlife under threat from extinction.

During the 2019/2020 season, over 600 moth sightings were recorded by the general public and uploaded into Moth Tracker, including 160 verified Bogong Moth sightings. Moth Tracker has been re-launched this year to track moth migration for the 2020/2021 season. This year, the public is again encouraged to take photos and provide locational information to accompany sightings of the moths. The data is then exchanged with other databases and technology platforms as required.

The partnership between CeRDI and Zoos Victoria has become firmly following the development of technologies that support citizen science initiatives associated with wildlife conservation. Zoos Victoria continues its collaboration with CeRDI through the extension of the Bogong Moth Tracker citizen science project.

Broad ranging benefits are anticipated through this collaborative project including improvements to the development and provision of technologies that encourage and promote citizen science. Information about the data collected by Zoos Victoria will be used to inform conservation efforts for the Mountain Pygmy-possum. Information will also be made available via key online platforms, including SWIFFT and Visualising Victoria's Biodiversity (VVB). It is hoped that the sharing of findings from the project will encourage existing and new citizen scientists to become active participants in, and recipients of new knowledge about the preservation of endangered Australian wildlife.

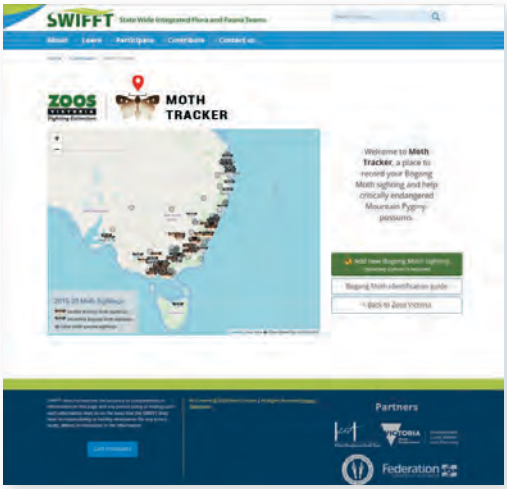
PROJECT PARTNERS

Zoos Victoria

Website: www.swifft.net.au/mothtracker

Zoos Victoria Fighting Extinction website: www.zoo.org.au/fighting-extinction

www.zoo.org.au/possums



Energy Data Roadmap

HAZARD PLANNING AND RESILIENCE

Federation University's School of School of Science, Engineering and Information Technology and CeRDI collaborated on research to understand the availability of energy data (consumption data) in Victoria.

Funded by the Centre for New Energy Technologies (C4NET), the Energy Data Roadmap has focused on electricity, mapping energy data landscapes and identifying opportunities for improved energy data access.

The Victorian electricity industry is a complex system where some, but not all, energy data is shared between industry stakeholders, which include distributors, the national market operator, and the energy retailers among others. This research will involve documenting data arrangements for energy consumption in Victoria by seeking insights from industry stakeholders and other organisations associated with the energy sector in Victoria and elsewhere.

Desktop research was be conducted to review current energy trends, influences, and drivers. Surveys and interviews were conducted with stakeholders to ensure deeper industry insights are achieved through sector engagement. The project was led by Federation University's Associate Professor Feng Xia with CeRDI conducting the data collection (surveys and interviews) from key stakeholders from the energy industry.

The research findings have been consolidated into a report for C4NET. The report includes detailed discussion informed by the desktop and research activities about new energy technologies for the sector. The desktop research comprised a comprehensive review of current energy trends, influences and drivers. Major initiatives in the energy, research and government sectors were identified and documented. Survey and interview data provided new insights about the energy data landscape, and identified barriers and inefficiencies pertaining to energy data. Opportunities for improved access to energy data were also explored through the research.

PROJECT PARTNERS

Centre for New Energy Technologies

For further information:

www.cerdi.edu.au/CentreforNewEnergyTechnologies

HAZARD PLANNING AND RESILIENCE

Climate Change Land Capability and Capacity Project

CeRDI is working with Bass Coast Landcare and colleagues from Federation University's Gippsland campus to develop a Climate Adaption Planning Tool for the Growing Southern Gippsland project.

Work on the decision support tool by CeRDI follows extensive planning about the tool's development, which was informed by feedback from over 200 local farmers. The tool will assist Southern Gippsland landowners in making decisions about managing their farming enterprises in parallel with predictions relating to the impact of climate change. The tool will enable landowners and farmers to prepare and plan for change in their region.

The tool will be structured into four main themes to assist with informed decision-making. These include 'land & ecosystem', 'water & rainfall', 'temperature & wind' and 'business & operations'. The tool will include additional data to support decision making. For example, climate data and soil data for the region will be available via the tool. This data will provide access to climate projection data for regions across Victoria, enabling visualisations of rainfall, temperature and humidity.

The tool has been designed to enable users to monitor their plans over time, and as new information is sourced, they can update their plans quickly and efficiently. The tool has been designed to be informative as well as user friendly. The development of the platform will provide users with a tool that captures current information to enable more accurate decision making, while minimising users time to complete input tasks.

This platform comprises one element of a broader project to support Southern Gippsland farmers and landowners to develop resilience to climate change. Case studies have also been developed to document the stories of successful climate change response and adaption from industry stakeholders. The stories will further elucidate the successful approaches that have been implemented in the region, complementing the decision-making capabilities offered through the tool.

Website: www.growingsoutherngippsland.org.au/AboutGrowingSouthernGippsland

PROJECT PARTNERS

Bass Coast Shire Council

South Gippsland Shire Council

Department of Environmental, Land, Water and Planning Victorian Government

Dementia Pathways Tool

HEALTH AND WELLBEING

Updates to Dementia Pathways Tool have been completed. CeRDI has worked closely with Associate Professor Mark Yates from Ballarat Health Services and Deakin University, and Caroline Gibson from Ballarat Health Services to review and update content and useful links on the tool.

The Dementia Pathways Tool was developed and launched in 2013 as a repository of information about dementia, and a pathways tool to assist general practitioners, practice nurses, and carers navigate information about diagnosis, service referrals and care for patients with dementia. The tool has since undergone numerous modifications, ensuring its content remains current and relevant, and new information is available to users of the tool.

Additional content under development for future integration within the tool includes dementia-specific green prescriptions linked to local parks and walks. Updated weblinks and content for essential reporting and assessment are also underway. New and updated links to key resources will continue to be made available.

A recent review of the user analytics for the Dementia Pathways shows consistent and strong user history for the tool. The review and updates to the tool will ensure that it remains a current and informative source for all that use it.

PROJECT PARTNERS

Ballarat Health Services

Deakin University

Website:
www.dementiapathways.com.au/

HEALTH AND WELLBEING

The Dementia Care in Hospitals program

The Dementia Care in Hospitals program is an initiative of Associate Professor Mark Yates (Ballarat Health Services and Deakin University) and Ballarat Health Services.

The program aims to reduce the risks for people with dementia when they are in hospital. A key feature of the program is an e-learning module to improve the training of acute hospital staff to respond appropriately to support patients with dementia. The program, which is an 'all of hospital' education program, is designed to improve the awareness of and communication with patients with dementia and is linked to a visual alert called the cognitive impairment identifier (CII).

The Dementia Care in Hospitals program was introduced at Ballarat Health Services in 2003 with the support of the Department of Health. The program was integrated as an online e-learning module following collaboration with CeRDI in 2017. CeRDI continues to support this program and provides regular updates to the e-learning modules in response to updates dementia care. CeRDI works closely with the project lead, and content experts, including Federation University Australia's Professor Britt Klein, Research Leader, Health Innovation and Transformation Centre.

Implementation of the program has facilitated significant cultural and practice change in the care of patients with memory and cognitive difficulties enabling improvements in staff and carer satisfaction. The Dementia Care in Hospitals program was established following focus group work with patients with dementia and their carers, which was conducted in association with Dementia Australia.

Website: www.dchp.com.au

PROJECT PARTNERS

Ballarat Health Services

Deakin University

Youth C.A.N. project

HEALTH AND WELLBEING

The Youth C.A.N. project commenced in 2016 following the awarding of funding for the project from VicHealth. Co-ordinated by Horsham Rural City Council (HRCC), the project aimed to capture insights to inform an understanding of the current practices of alcohol consumption and alcohol misuse in the region, and to identify opportunities for cultural change to reduce alcohol use.

CeRDI conducted extensive research to evaluate the project which, under the leadership of Dr Angela Murphy, culminated in the release of the final report. The report incorporates extensive research findings from the project and how it has been supported and benefitted culture change around alcohol for young people in the region.

The successful implementation and outcomes from the Youth C.A.N. project led to its identification as an exemplar for and integration within VicHealth's Alcohol Cultures Framework. The guide for supporting practitioners to use the Alcohol Cultures Framework includes exemplary case studies from three alcohol culture change in the community. Each of the three case studies in the framework offer insights about the successful programs and approaches that have been utilised across Victoria, leading to practice change. The Youth C.A.N. project represents the strategies for cultural change leading to safer, reduced alcohol consumption for young people (aged 15–20 years) in Horsham, which has relevance for other regional areas across the state.

The guide was developed by VicHealth in consultation with key stakeholders involved in delivering and evaluating alcohol culture change projects as part of the VicHealth Alcohol Culture Change Initiative 2016–2019. The guide can be used in conjunction with other key resources for supporting health promotion practitioners, local government policy makers and community organisations to take action on risky drinking cultures.

PROJECT PARTNERS

Horsham Rural City Council

Grampians Community Health

Victoria Police

Wimmera Primary Care Partnership

Wimmera Regional Sports Assembly

Wimmera Southern Mallee Local Learning and Employment Network

Wimmera Uniting Care

Wimmera Health Group

Ambulance Victoria

Victorian Department of Health and Human Services

For further information about the Youth C.A.N. project: www.cerdi.edu.au/YouthChangingAlcoholNorms

The Alcohol Cultures Guide: Taking Action on Risky Drinking Cultures:
www.vichealth.vic.gov.au/-/media/ResourceCentre/PublicationsandResources/alcohol-misuse/Alcohol-Cultures-Guide.pdf?la=en&hash=D8EB62BE05F838F6098B6FF07227542704CED75B

HERITAGE AND CULTURE

Avenue of Honour project

CeRDI received a small grant to assist the Ballarat Avenue of Honour Committee improve the spatial accuracy of The Avenue's trees and commemorative plaques.

Until recently, only un-corrected GPS had been used to document the 3600 trees along The Avenue. This work was completed many years ago, and with modern photography there were recent indications that the documentation of tree points was out of position.

Free access to high resolution imagery collected during winter 2019 when the leaves had fallen from the trees and their trunks and bases were visible was supplied by EagleView. The new imagery enabled the relocation of tree points to the correct position.

A second stage in the project involved a field visit to the remaining 330 trees in The Avenue. Arrow GPS (supplied by Peter Terrett from 4DGlobal) was used to verify each tree. Peter provided extensive assistance with this, and together with CeRDI's Rick Pope, was able to run QGIS Field, a sophisticated GIS software program to verify tree positions using a mobile phone. The phone was connected to the Arrow 100 via Bluetooth with a QGIS project with a 16 GIG geo-referenced Tif enabling all the tree points to be verified.

These collaborative efforts and technologies were successful, with the results yielding high consistency and accuracy, chieved to 1.5m accuracy under the canopy. The outcomes exceeded all expectations. Many thanks to 4DGlobal for their support with the project.

PROJECT PARTNERS

Ballarat Avenue of Honour Committee

4DGlobal

For further information:
https://honouringouranzacs.com.au

Virtual Honour Roll

HERITAGE AND CULTURE

CeRDI has commenced a project with the Ballarat RSL to establish a virtual Honour Roll to record the men and women from Ballarat and surrounding districts that enlisted during World War II.

Funded by the Department of Veteran's Affairs through the Commemorative Grants program, this project will ensure public access to information about residents who served during World War II.

CeRDI will develop the web platform to host the honour board data that will be embedded within the existing Ballarat RSL website. Key functionality for the website will include an information display, with search functions (name, location, unit, date), and the facility for user contributions (text, images).

Until now, the names of Ballarat residents who served in World War II were available only as a hard copy. The development of a virtual honour roll will allow family members of the service personnel and other members of the public to access details about those that served, including the service number, name, rank and branch of service, and enlistment dates. Additional features planned for the website will enable the placing of a virtual poppy against names on the Honour Roll.

This project will contribute new insights about the significant contribution that this region's men and women made during World War II. The project will involve close liaison with Ballarat RSL, with data to be sourced from the Shrine of Remembrance and the Department of Veterans' Affairs.

PROJECT PARTNERS

Australian Government – Department of Veteran's Affairs

Ballarat RSL

Website:
www.cerdi.edu.au/VirtualHonourRoll

REGIONAL DEVELOPMENT

Smart Cities and Ballarat Open Data platform

A successful collaboration between the City of Ballarat and Federation University has led to the creation of an innovative, open data sharing platform for the community.

Ballarat Open Data is a platform for community data sharing that will enable greater regional innovation through data driven decision making, and offer new opportunities by harnessing the Internet of Things.

Preliminary work associated with the development of this platform involved pilot studies and the implementation of smart sensors and devices for evidence-based decision making. The studies have informed the understanding of, and opportunities for the Internet of Things and new technology infrastructure, through the open LoRaWAN (Long Range, low power Wide-Area Network) service for the region.

The community-based open data sharing platform represents a major outcome for the project, complementing and extending the insights gained during the piloting phase. Ballarat Open Data incorporates datasets generated from the pilot studies, along with other (raw) data that has been shared by local organisations and community groups. The platform enables the City of Ballarat, Federation University, local start-up businesses and the community to identify opportunities facilitated by data access and usage.

CeRDI has been instrumental in developing the data platform, with Associate Professor Helen Thompson, Dr Angela Neyland and Scott Limmer leading this part of the project. Features of the data platform include a sustainability dashboard that visualises the latest data for the region on waste, energy use and water use. Analysis of data sets from sensors installed locally is currently being used to inform how COVID19 has impacted the community's mobility, waste, traffic and energy use during lockdown. It is anticipated that visualisations associated with this data will demonstrate the value of the open data sets available at Ballarat Open Data.

The project team are now looking to expand the Ballarat Open Data platform through consultation with the City of Ballarat and other organisations. Discussions are underway with the Centre for New Energy Technologies (C4NET) for energy-usage dataset for the Ballarat area. This dataset, along with others included in the platform have the potential to add important new datasets to Ballarat Open Data in the future. This will enable downloads for use by organisations, businesses and the general public providing key information about sustainability in the Ballarat region.

PROJECT PARTNERS

City of Ballarat

Ballarat Hacker Space

Meshed

Federation University: Ballarat Technology Park, ITS, Facilities Services, Library and UniSports

Website:
https://ballaratopendata.org.au/

For further information:

www.cerdi.edu.au/cb_pages/city_of_ballarat_smart_cities_and_suburbs.php

Staff profiles

Research

Associate Professor Helen Thompson,
Director

Doctorate of Business Administration, Bachelor of Commerce (Accounting) with Distinction

Helen has led the Centre since 2002 and is responsible for the achievement of all CeRDI organisational objectives in respect of research, project management, partner projects, business development and financial management. Under Helen's leadership, CeRDI has become one of the University's most successful research centres, establishing a reputation for excellence at the regional, national and international level. Helen has organisation-wide leadership for eResearch. She is engaged in research into the use of ICT and is involved in a range of activities which contribute to the economic and social development of regional and rural Victoria.

Associate Professor Peter Dahlhaus,
Senior Research Fellow

PhD, Master of Applied Science, Bachelor of Applied Science

Peter joined CeRDI in 2012 as an experienced researcher and geologist. He has a comprehensive knowledge of the geology, geomorphology and hydrogeology of south west Victoria, where he has been influential in applying his scientific knowledge to direct policy on salinity and soil health management as an author of catchment action plans and strategies, and municipal planning overlays. Together with colleagues at CeRDI, Peter's current research focuses on spatial data interoperability and visualisation to ensure that natural resource management data, information and knowledge is globally available to researchers, government agencies, municipalities and the public. Peter is the lead researcher on numerous projects, including the Visualising Australasia's Soils.

Dr Nathan Robinson, Senior Research Fellow, Soil Science

PhD, Bachelor of Applied Science (Honours), Graduate Diploma (GIS and remote sensing)

Nathan joined CERDI in 2017 after working in soil and landscape analysis for the Victorian government for 18 years. Nathan has been a lead researcher in the use of proximal sensors and rapid sensing techniques in the assessment of soil properties and links to crop yield. Nathan completed his PhD at Federation University in 2016 and his role in CeRDI is closely linked to his PhD and Soil Science where he is conducting research on advancements to spatial analysis to better understand the links between soil and the agricultural production systems.

Dr Birgita Hansen, Senior Research Fellow; Food Agility Constellation Leader

PhD, Bachelor of Science (Evolutionary Ecology)

Birgita is leading the Food Agility CRC Better Data for Better Decisions research constellation, which aims to build a research program around improving the translation of data into knowledge that improves farm outcomes. She has extensive experience in ecology, environmental management and citizen science, with a strong focus on understanding the ecological response of birds to modification of their habitat. This has included studies of woodland birds in agricultural landscapes, and shorebird conservation, management and monitoring at local and continental scales.

Dr Alison Ollerenshaw, Research Fellow

PhD, Master of Applied Science, Graduate Diploma of Applied Science (Professional Psychology), Bachelor of Arts, Diploma Project Management

Alison joined CeRDI in 2012 providing research support across a range of Centre projects and activities. She has experience in research and project management, impact evaluation, and in the application of mixed methods research. In 2016, Alison returned to full-time study and completed her PhD in CeRDI examining the relationship between business incubator services and tenants' positive psychological constructs. Alison works in CeRDI on various projects.

Dr Amie Sexton, Research Fellow

PhD (Anthropology), Bachelor of Arts (Honours), Grad Dip Education,
Bachelor of Arts (French) and Bachelor of Music

Amie completed a PhD on the anthropology of wine production in France and Australia at The University of Melbourne in 2017. She has worked in education, marketing, events and as a freelance musician and artist, mostly in regional Victoria. Amie has a particular interest in the creative process, wine, stories, the arts, community and education. Amie contributes to CeRDI projects Online Farm Trials and Visualising Australasia's Soils.

Robert Milne, Project Manager

Bachelor of Applied Science (Environmental Management)

Rob joined CeRDI in 2013 bringing specialist skills in geographic information systems and data management. Rob has extensive project management and stakeholder engagement experience gained during his extensive career with Federation Uniiversity and as partner in the family farming business.

Bruce Simons, Research Associate

Bachelor of Science

Bruce has worked as a geophysicist in private industry and the Northern Territory and Victorian geological surveys. While at the Geological Survey of Victoria and, since 2012, at CSIRO, Bruce has designed information management systems and part of international and national collaborative research projects into data exchange mechanisms and interoperability. Bruce joined CeRDI in 2017 with the aim of making natural resource management data, information and knowledge globally available to researchers, government agencies, municipalities and the public, while minimising the overheads to data providers.

Dr Megan Wong, Research Associate

PhD, Graduate Diploma of Education, Bachelor of Science

Megan joined CeRDI in 2017 and brings a broad range of experience gained across 15 years in the Science, Environment and Education sectors. Megan completed her PhD in 2014 at Monash University investigating the association of soil biology with vegetation and land use change across the Riverine Plains of Victoria. Megan has worked extensively on the AgReFed project.

Dr Angela Neyland, Research Officer

PhD, Bachelor of Arts (Honours), Bachelor of Science

Angela commenced at CeRDI in 2017 after graduating with a PhD from the Australian National University. Angela has a diverse research background encompassing both earth sciences and social sciences with a BSc/BA with honours in geology and archaeology from the University of Queensland. Angela's unique range of experiences and skills are being applied in CeRDI across various projects relating to natural resource management, digital agriculture and cultural heritage.

Jennifer Corbett, Research Officer

Bachelor of Management (Honours) (Marketing)

Jennifer joined CeRDI in 2009. She provides research coordination and support to a range of projects including regional ICT studies and projects in the agriculture sector.

Kate Light, Research Officer

Master of Agriculture

Kate is a specialist in breeding canola with disease (blackleg) resistance. In CeRDI, Kate is a key member of the Online Farm Trials team, contributing her agriculture knowledge and expertise to this project.

Derek Walters, Project Officer

Bachelor of Applied Science (Honours)

Since completing his undergraduate degree (Geology), Derek has worked in hydrogeology, as exploration and production geologist, and recently as a data analyst with the Department of Environment, Lands, Water and Planning. Derek completed his honours degree in 2015 for which he received the Professor Ferdinand Mortiz Krause Medal for excellence in geology. Derek commenced with CeRDI in 2018, working primarily on updates to Visualising Victoria's Groundwater portal.

Dr Joel Epstein, Research Associate (part-time)

PhD

Joel has been working with CeRDI since 2015, providing support to the SLT and Director on a range of activities including strategic planning. Joel has a PhD in Chemical Physics and over thirty years' experience in strategic planning. Prior to CeRDI, Joel worked at Kodak and the University of Ballarat.

Rick Pope, Research Associate

Graduate Diploma in Land Rehabilitation

Rick commenced working for CeRDI in 2015 and has extensive expertise in geographic information systems (GIS) and global positioning systems (GPS). Rick has a close working relationship with local government, the spatial industry as well as Landcare networks in Victoria, Queensland and Western Australia. In CeRDI, Rick has been involved with many projects, including the recent rating curve and water balance model for the Winton Wetlands.

Chris Bahlo, Research Associate

Bachelor of Information Technology (Honours), Bachelor of Information Technology (Professional Practice), Bachelor of Business, Diploma of Agricultural Science

Chris has worked in information technology and agriculture roles and has business experience. She is completing her PhD in CeRDI and is researching data interoperability in precision agriculture.

Patrick Bonney, Research Associate

Master of Science (Zoology), Bachelor of Science

Patrick is undertaking research examining citizen science and public policy. He is completing his PhD in CeRDI and is measuring and exploring the issues and opportunities of the Waterwatch Victoria and EstuaryWatch Victoria programs.

Jude Channon, Research Officer

Master of Education, Bachelor of Arts,

Jude worked as a research officer with CeRDI in 2017 and in 2019 returned to CeRDI after taking time out to implement a large-scale healthcare project across regional Victoria. Jude provides extensive support and is a key member of the Online Farm Trials team.

Dr Judi Walters, Research Associate

PhD (Forest Ecology), Master of Science, Bachelor of Forest Science (Honours), Diploma of Arts (Professional Writing and Editing)

Judi commenced at CeRDI in 2015 having worked extensively within the field of scientific research, publishing and editing from within a range of organisations and universities spanning fields such as forest ecology, bushfire research and contaminated lands auditing. Judi is part of the Online Farm Trials team.

Technical

Andrew Macleod, Manager Technical Projects

Honours Applied Science (Information Technology), Bachelor of Computing

Andrew has extensive experience in project planning and the implementation of major information technology projects. He provides technical leadership for all Centre activities. Andrew has been instrumental in developing the technology innovations, data interoperability and knowledge management approaches demonstrated through CeRDI spatial initiatives.

Paul Feely, Senior Systems Analyst Programmer

Bachelor of Computing (Honours)/Bachelor of Commerce

Paul joined CeRDI in 2003. He specialises in PHP and MySQL development and has been the lead programmer on major projects including Sport and Recreation Spatial and Online Farm Trials.

Scott Limmer, Systems Analyst Programmer

Bachelor of Information Technology

Scott joined CeRDI in 2008 providing assistance with expanding programming and web development activities. He has introduced new multimedia and web2 technology skills to the team and has been the technical lead on various decision support and IoT projects, including the current server migration project.

Heath Gillett, Senior Programmer

Bachelor of Computing

Heath joined CeRDI during 2009. He has extensive experience in design, programming, implementation and support of various IT systems. Heath has been a lead developer on key projects in CeRDI including Visualising Australasia's Soils, Precision Agriculture and the Victorian Fire Risk Register.

Craig Briody, Web Developer

Bachelor of Computing

Craig specialises in the development and implementation of web-based projects as well as having significant experience in the development and delivery of comprehensive client training programs.

Sudeera Abeywickrema, Web Developer

Bachelor of Information Technology

Sudeera joined CeRDI in 2013 and contributes to the implementation of a range of web-based applications and systems and the integration of emerging technologies to enhance CeRDI outcomes.

Dan Ferguson, Technical Assistant

Bachelor of Computer Science (Professional)

Dan joined CeRDI in 2019 and provides technical assistance across a range of projects.

Project and Administration Support

Kathy Gamble, Administrative support officer

Graduate Diploma of Education, Diploma of Fine Art

Kathy joined CeRDI in January 2013 after five years with the Federation Business School. Kathy provides administrative assistance and support for the CeRDI team. Kathy is also the personal assistant to the Centre Director.

Peter Codd, Project Coordinator

Bachelor of Applied Science, Diploma of Business Management

Peter commenced part-time work with CeRDI in 2018, assisting in updating the historical data on the Natural Resource Management Planning Portal for the Corangamite region. Peter's career spans over 40 years, having worked for the Victorian government and Corangamite Catchment Management Authority in various roles.

Higher Degrees by Research Candidates

Alison Ollerenshaw, PhD candidate

PHD TITLE:	The relationship between business incubator services and the psychological capital of tenants
SCHOOL:	Science, Psychology and Sport
YEAR COMMENCED:	2016
SUPERVISORS:	Dr Angela Murphy, Associate Professor Helen Thompson, Professor Suzanne McLaren

Chris Bahlo, PhD candidate

PHD TITLE:	Open data and interoperability standards: opportunities for animal welfare in extensive livestock systems
SCHOOL:	Engineering, IT and Physical Sciences
YEAR COMMENCED:	2016
SUPERVISORS:	Associate Professor Peter Dahlhaus, Associate Professor Helen Thompson

Patrick Bonney, PhD candidate

PHD TITLE:	Citizen science: Knowledge, networks and the boundaries of participation
SCHOOL:	Science, Psychology and Sport
YEAR COMMENCED:	2016
SUPERVISORS:	Dr Angela Murphy, Dr Birgita Hansen, Dr Claudia Baldwin (USC)

Basharat Ali, PhD candidate

PHD TITLE:	Investigating the roles of data, digital agriculture and resilience in agricultural performance.
SCHOOL:	Engineering, IT and Physical Sciences
SUPERVISORS:	Associate Professor Peter Dahlhaus, Associate Professor Helen Thompson, Dr Nathan Robinson

Elissa Ashton-Smith, PhD candidate

PHD TITLE: The conservation and management of sandy beach ecosystems: Exploring the divergence between policy, science and socio-cultural expectations for stewardship and use.

SCHOOL: Science, Psychology and Sport

SUPERVISORS: Dr Jessica Reeves, Associate Professor Fred Cahir, Dr Birgita Hansen

Rekha Attanayake, PhD candidate

PHD TITLE: Developing new methods to help farmers make decisions on lime use and lime requirement.

SCHOOL: Engineering, IT and Physical Sciences

SUPERVISORS: Associate Professor Peter Dahlhaus, Dr Nathan Robinson, Lisa Miller

Rob Clark, PhD candidate

PHD TITLE: Predicting crop yield within the growing season at sub-paddock scale: a big data approach.

SCHOOL: Engineering, IT and Physical Sciences

SUPERVISORS: Associate Professor Peter Dahlhaus, Dr Nathan Robinson, Dr Elizabeth Morse-McNabb

Peter Weir, PhD candidate

PHD TITLE: In-Paddock variability of plant available water

SCHOOL: Engineering, IT and Physical Sciences

SUPERVISORS: Associate Professor Peter Dahlhaus, Dr Nathan Robinson, Associate Professor Peter Vamplew

Derek Walters, PhD candidate

PHD TITLE: Port Phillip Bay: the real value of groundwater

SCHOOL: Engineering, IT and Physical Sciences

SUPERVISORS: Associate Professor Peter Dahlhaus, Dr Ander Guinea

Higher Degrees by Research Alumni

Dr Alison Ollerenshaw, PhD

THESIS TITLE

The relationship between business incubator services and the psychological capital of tenants

SUPERVISORS

Dr Angela Murphy, Associate Professor Suzanne McLaren, Associate Professor Helen Thompson

SCHOOL

Science, Psychology and Sport

ABSTRACT

Business incubators are supportive environments where new tenant-businesses grow to independence. Incubators offer characteristic services including (a) space, physical resources, and infrastructure; (b) business support services, (c) networking; and, (d) structured selection, entry, and exit. Despite the global growth in incubators, gaps in knowledge remain. Little research has examined the relationship between incubator characteristic services and tenants' psychological capital; a higher-order construct representing an individual's positive psychological state of development that includes hope, efficacy, resilience, and optimism.

Preliminary examination of the characteristic services at incubators suggest they are analogous with interventions for developing psychological capital. Two research studies examined these relationships. In the first study, survey (n = 30) and interview data (n = 12) were collected from incubator tenants to examine the existence of a relationship between the four characteristic services at incubators and tenants' psychological capital, hope, efficacy, resilience, and optimism. The survey data confirmed the existence of a relationship between three incubator services – space, physical resources, and infrastructure, business support services, and networking – and tenants' psychological capital. Tenants' narrative experiences confirmed that these same three incubator services support tenants' hope, efficacy, resilience, and optimism.

To further elucidate these relationships a second study was conducted. Survey (n = 75) and interview (n = 28) data from incubators managers also confirmed that space, physical resources, and infrastructure, business support services, and networking were analogous with methods that support tenants' hope, efficacy, resilience, and optimism. This research provides robust evidence that three characteristic services at incubators are associated with tenants' psychological capital, hope, efficacy, resilience, and optimism.

These findings are novel, and the implications for the incubator industry, wide-ranging. Proposed new directions for the industry include establishing a consistent approach to delivering the characteristic services at incubators that support tenants' businesses, and their positive psychological development.

Research Outputs

Book Chapters

Hansen B., Ura, T., Tajiri, H., Dutson, G., & Garnett, S.T. (2020). Latham's Snipe Gallinago hardwickii. In A*ction Plan for Australian Birds 2020*. (Eds ST Garnett and GB Baker) CSIRO Publications: Melbourne.

Journal Publications

Attanayake, R. R., Weller, S. L., & Singarayer, F. K. (2020) Seed germination response of a potential rangeland weed *Psilocaulon granulicaule* to selected environmental conditions. *Australian Journal of Botany,* 68, 363-368. https://doi.org/10.1071/BT20060

Benke, K.K., Norg, S., **Robinson**, N.J., Chia, K., Rees, D.B., & Hopley, J. (2020). Development of pedotransfer functions by machine learning for prediction of soil electrical conductivity and organic carbon content. *Georderma*, 366. Doi: https://doi.org/10.1016/j.geoderma.2020.114210

Bonney, P., **Murphy**, A., **Hansen**, B., Baldwin, C. (2020) Citizen Science in Australia's Waterways: Investigating Linkages With Catchment Decision-Making. *Australasian Journal of Environmental Management*, 27, 200-223. https://doi.org/10.1080/14486563.2020.1741456

Fuller, R.A., Jackson, M.V., Choi, C-Y., Clemens, R.S., **Hansen**, B.D., Steven R., Woodworth, B.K. (2020). Collect, connect, upscale: Towards coordinated large-scale monitoring of migratory shorebirds in the Asia-Pacific. *Australian Zoologist*. https://doi.org/10.7882/AZ.2020.027

Hansen, B.D., Reviakina, Z., Kulikova, O., Ktitorov, P. (2020). An overview of the Latham's Snipe population in Sakhalin, Eastern Russia. *Stilt*, 73-74, 52-28.

Horsup, A., Austin, J., Fewster, R.M., **Hansen**, B.D., Harper, D., Molyneux, J., Taylor, A., White, L. (2020). Demographic trends and reproductive patterns in the northern hairy-nosed wombat (Lasiorhinus krefftii) at Epping Forest National Park (Scientific), central Queensland. *Australian Mammalogy* 43 (1), 72-84. https://doi.org/10.1071/AM20030

Kidd, D., Searle, R., Grundy, M., McBratney, A., **Robinson**, N., O'Brien, L., Zund, P., Arrouays, D., Thomas, M., Padarian, J., Jones, E., Bennett, J. M., Minasny, B., Holmes, K., Malone, B. P., Liddicoat, C., Meier, E. A., Stockmann, U., Wilson, P., Wilford, J., Payne, J., Ringrose-Voase, A., Slater, B., Odgers, N., Gray, J., van Gool, D., Andrews, K., Harms, B., Stower, L., & Triantafilis, J. (2020). Operationalising digital soil mapping – Lessons from Australia. *Geoderma Regional*, 23, e00335. https://doi.org/10.1016/j.geodrs.2020.e00335

Walters, J.R., **Light**, K., & **Robinson**, N. (2020). Using agricultural metadata: an novel investigation of trends in sowing date in on-farm research trials using the Online Farm Trials database. *F1000Research*. Available at https://f1000research.com/articles/9-1305/v1.

Zilko, J.P., Harley, D., **Hansen**, B., Pavlova, A., Sunnucks, P. 2020. Accounting for cryptic population structure enhances detection of inbreeding depression: An example from a critically endangered marsupial. *Molecular Ecology* 29, 2978-2993. https://onlinelibrary.wiley.com/doi/abs/10.1111/mec.15540

Conference Papers and Presentations

Ali, B. (2020). Relationship between precision conservation agricultural practices and agricultural performance: the moderating role of FAIRness of data and resilience in Australia. *Food Agility Summit 2020*, University of Technology, Sydney on 10–11 February 2020.

Attanayake, R. (2020). Developing an online tool for comparison of lime application. *Food Agility Summit 2020*, University of Technology, Sydney on 10–11 February 2020.

Box, P., **Wong**, M., **Simons**, B., Levett, K., Lee, A., **Thompson**, H., **Epstein**, J., **MacLeod**, P. (2020). Building AgReFed: A reusable socio-technical design for community governance and data stewardship. *Collaborative Conference on Computational and Data Intensive Science C3DIS 2020*, Melbourne Convention and Exhibition Centre, 16-20 March 2020. http://www.c3dis.com/3939

Clark, R. (2020). Predicting crop yield within the growing season at sub-paddock scale: a big data approach. *Food Agility Summit 2020,* University of Technology, Sydney on 10–11 February 2020.

Hansen, B., & **Bonney**, P. (2020). Conference presentation. Citizen Science: a tool for ecology, conservation and science communication. *Ecological Society of Australia Conference*. 30 November – 3 December 2020.

Walters, D. (2020). Port Phillip Bay – The Real Value. *32nd Victorian Universities Earth and Environmental Sciences Conference*, Melbourne, 27 February.

Other outputs

Wong, M., Box, P., **Epstein**, J., Lee, A., **Thompson**, H., Levett, K., **Channon**, J., Wilson, P., Taylor, N., Hergenhan, R., Berger, B., Gilliham, & M. (2020, March 10). Agricultural Research Federation (AgReFed) Steering Policies, Roles and Responsibilities (Version 1). Zenodo. http://doi.org/10.5281/zenodo.3707046

MacLeod, A., **Wong**, M., Gregory, L., Schneider, D., Williams, A., Castleden, I., **Simons**, B., Levett, K., & Box, P. (2020, May 13). The Agricultural Research Federation (AgReFed) Technical and Information Policy Suite (Version 1.0). Zenodo. http://doi.org/10.5281/zenodo.3993784

ARDC newsletter

Dr Megan Wong was featured in the April issue of the Australian Research Data Commons (ARDC) newsletter. Megan is now the Secretariat for the Agricultural Research Federation (AgReFed), a community whose establishment was supported by the Australian Research Data Commons (ARDC):
https://ardc.edu.au/news/dr-megan-wong-a-biologist-and-data-enthusiast/

For more information about AgReFed: http://www.cerdi.edu.au/AgReFed

Research Income

Research income for the Centre between 2016 and 2020 is presented in the following graphs. The first figure shows the key performance measures of overall income have remaied stable overtime and increasing in 2020.

Income allocation across research themes is presented in Figure 3. It highlights that income generation from research in agriculture has increased significantly across the reporting period.

CeRDI Income 2016–2020

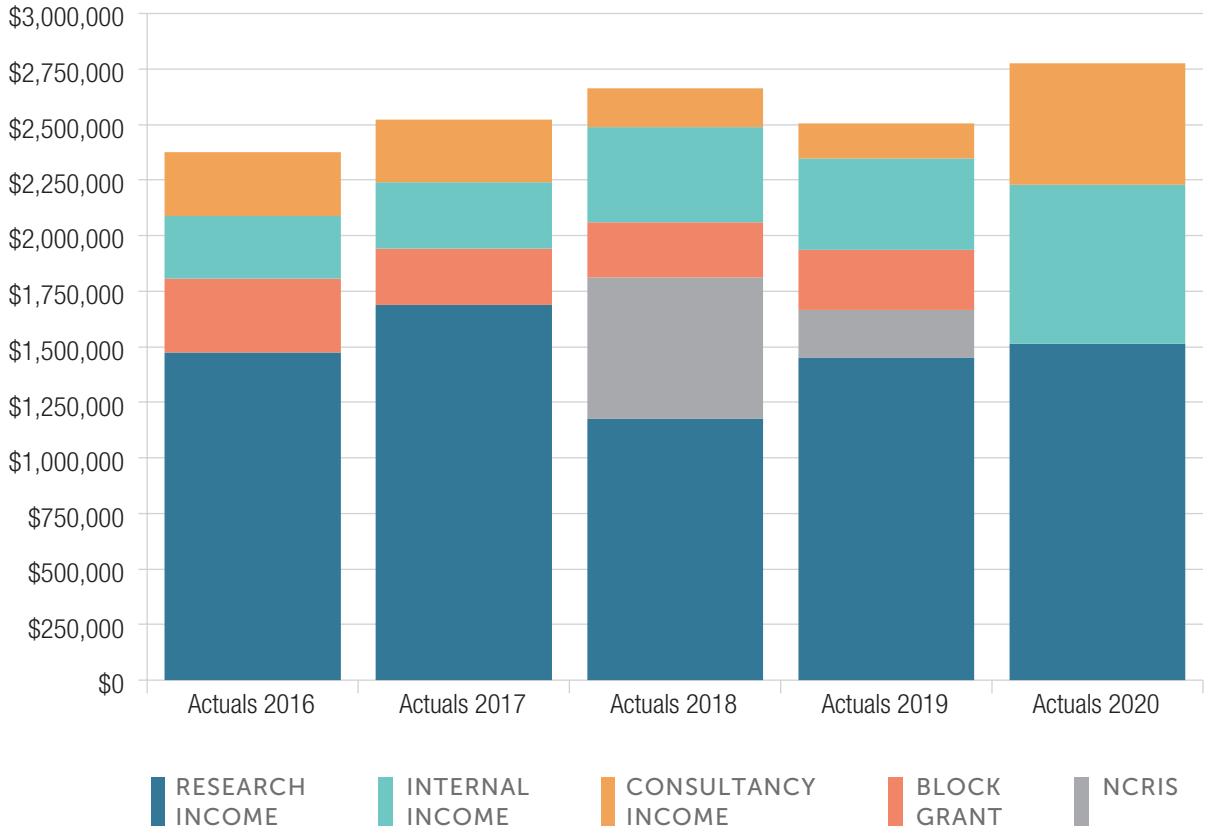


FIGURE 2. CeRDI INCOME BY SOURCE BETWEEN 2016 AND 2020.

Note. The NCRIS (National Collaborative Research Infrastructure Strategy) funds the Australian Research Data Commons AgReFed project.

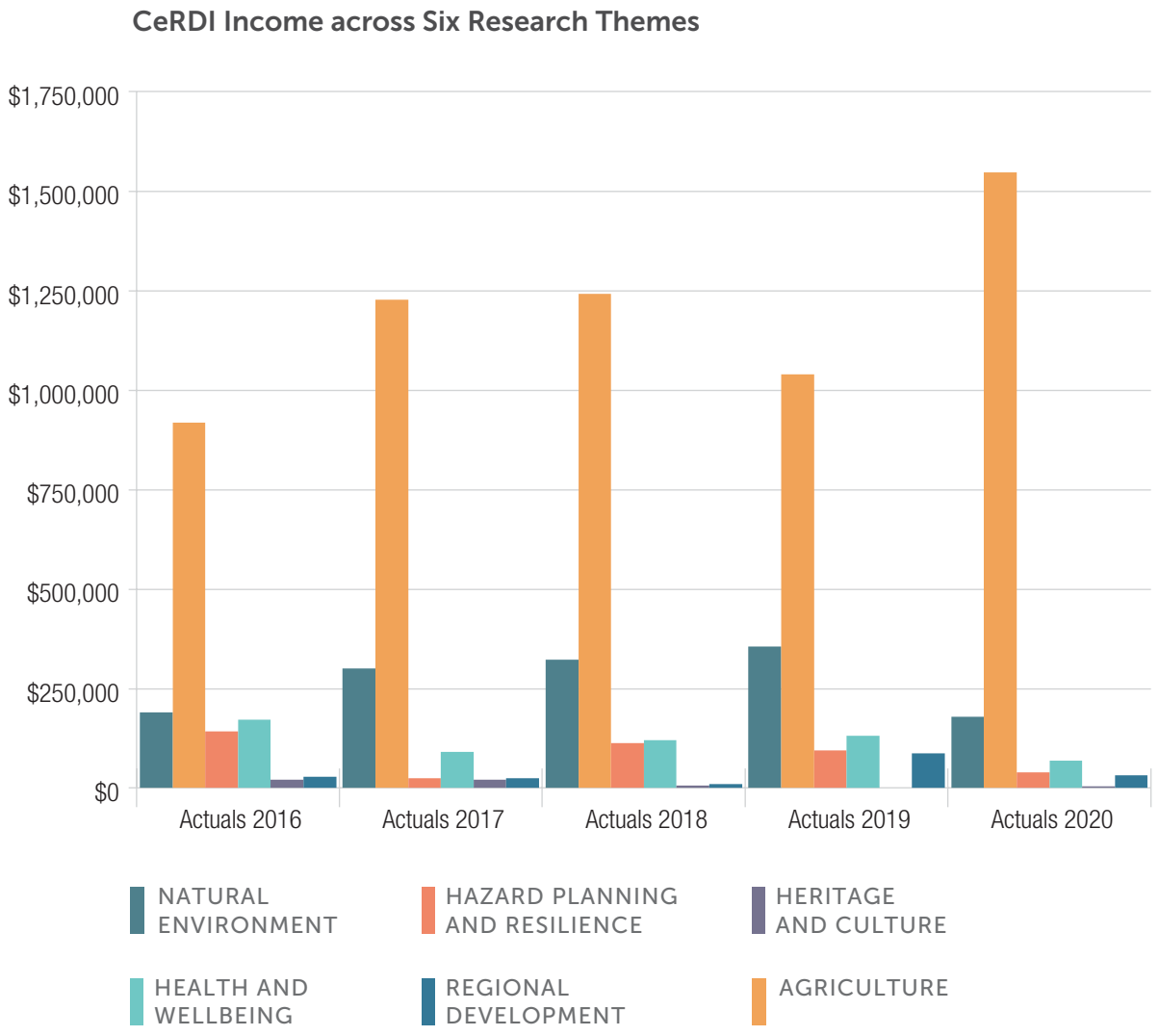


FIGURE 3.
CeRDI INCOME BETWEEN 2016 TO 2020 ACROSS THE SIX RESEARCH THEMES.

Research Partnerships and Collaborations

4DGlobal

Ag Excellence Alliance (South Australia)

Agriculture Kangaroo Island

Agriculture Victoria

Ambulance Victoria

Atlas of Living Australia

Australian Fertiliser Services Association

Australian Government – Department of Veteran's Affairs

Australian Government – National Landcare Program

Australian National University

Australian Plant Phenomics Facility

Australian Research Data Commons

Ballarat Avenue of Honour Committee

Ballarat Hacker Space

Ballarat Health Services

Ballarat RSL

Barwon Coast Committee of Management

Ballarat Community Health

Bass Coast Shire Council

Beach Patrol

Bellarine Catchment Network

Birchip Cropping Group

Birdlife Australia

Brimbank City Council

Burdekin Productivity Services

Capital Woodlands and Wetlands Conservation Association Inc

Central West Farming Systems Inc.

Centre for New Energy Technologies

City of Ballarat

City of Greater Geelong

City of Kingston

Commerce Ballarat

Cooperative Research Centre for High Performance Soils

Cooperative Research Centre for Spatial Information (CRCSI)

Corangamite Catchment Management Authority

Country Fire Authority

CSIRO

Deakin University

Department of Economic Development, Jobs, Transport and Resources Victorian Government

Department of Environment, Land, Water and Planning

Department of Environment, Land, Water and Planning | Arthur Rylah Institute for Environmental Research

Department of Industry, Science, Energy and Resources

Department of Jobs, Precincts and Regions, Victorian Government

Earlham Institute

EcoCommons, Griffith University

Environmental Protection Authority Victoria

Field Applied Research Australia

Food Agility Cooperative Research Centre

Food and Agriculture Organization of the United Nations

Foundation for Rural and Regional Renewal

Geoscience Australia

Gillamii Centre

Glenelg Hopkins Catchment Management Authority

Goulburn Murray Water

Grains Research and Development Corporation

Grampians Community Health

Griffith University

Grower Group Alliance

Gunaikurnai Traditional Owner Land Management Board

Herbert Cane Productivity Services Ltd
Holbrook Landcare Network
Horsham Rural City Council
International Plant Nutrition Institute
Legal Services Commission of South Australia
Liebe Group
Lloyd Environmental
Love Our Street
MacKillop Farm Management Group
Macquarie University
Marcus Oldham College
Meshed
National Research Infrastructure Strategy
Natural Resources Canada
Nicon Rural Services
North Central Catchment Management Authority
Northern Grower Alliance
NSW Department of Primary Industries
Nutrien (formerly Landmark)
Port Phillip Bay Fund
Port Phillip EcoCentre
Precision Agriculture
Queensland Cyber Infrastructure Foundation
Queensland University of Technology
Regional Universities Network
Riverine Plains Inc
RMIT
Seeding Victoria
Senversa Pty Ltd
Soil CRC
Southern Farming Systems
South Gippsland Shire Council
Southern Rural Water
Stirlings to Coast Farmers (Western Australia)
Sustainability Victoria
Techcrop
TERN, The University of Queensland
Thiess Services Pty Ltd
The University of Adelaide
The University of Sydney
The University of Western Australia
University of Southern Queensland
University of Tasmania
Victoria Police
Victorian Department of Health and Human Services
Victorian Department of State Development, Business and Innovation
Victorian eResearch Strategic Initiative (VeRSI)
Victorian Grower Group Alliance
Victorian Lime Producers Association
Victoria State Emergency Services
Western Australia No Till Farmers Association
West Midlands Group
Wimmera Catchment Management Authority
Wimmera Health Group
Wimmera Primary Care Partnership
Wimmera Regional Sports Assembly
Wimmera Southern Mallee Local Learning and Employment Network
Wimmera Uniting Care
Woady Yaloak Catchment Group
Yarra Riverkeeper Association
Zoos Victoria

Contact CeRDI

For further details about CeRDI's diverse portfolio of research please visit our website: **www.cerdi.edu.au**

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