

Data-based platforms for enhancing agriculture in Oceania.

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Abstract

Crop performance data platforms have emerged as essential tools for the agricultural sector. Their purpose is to consolidate and organize vast amounts of data, enabling evidence-based decision-making. In this context, we explore the significance of these platforms and their potential impact on agricultural practices.

As agriculture becomes increasingly data-intensive, farmers and stakeholders require reliable information to optimize operations. Crop yields, phenology, pest incidence, and irrigation/fertilization data are critical inputs for decision support systems (DSS). However, accessing and interpreting the data can be challenging. Therefore a comprehensive review of existing platforms is necessary to address this gap. The agricultural landscape involves various stakeholders—farmers, researchers, educators, and businesses. Each group has distinct needs and interests. By evaluating available platforms, we aim to link the gap between data availability and stakeholder requirements. Our review focuses on two prominent platforms: AgReFed (Australia) and AgYields (New Zealand) databases. These platforms enhance discoverability, trustworthiness, and usability of agricultural research data. By providing accessible benchmarks and analysis-ready information, they empower farmers, rural professionals, and researchers. Our findings highlight areas for improvement, ensuring a more resilient and sustainable agricultural sector.

Keywords

Data systems, information, agriculture platforms, technology, productivity

Introduction

Agriculture is a major share of the Australian economy and a significant contributor to global food security by producing sufficient food for ~60 million people (ABS, 2023) with a production value of AUD 94 billion in 2022-23 and 70% being exported (Department of Agriculture, Fisheries and Forestry 2024). Approximately 50% of Australia's 760 million-hectare land is devoted to agricultural production with the majority consisting of very low intensity/input grazing systems (Pannell and Rogers, 2022) and broadacre cropping systems (An-Vo *et al.*, 2018). In New Zealand, agriculture is economically vital and deeply embedded in New Zealand's cultural heritage and land use practices. It sustains livelihoods, contributes to exports, and shapes the nation's identity (Caradus *et al.*, 2023). Raw and processed agricultural products worth NZ\$ 57.4 billion, accounting for ~79.6% of total exports (MPI, 2023). Environmental conditions, soil and climate variability, input prices, farming scales and commodity returns have heightened the importance of data decision support tools for farmers. They require forecasting information and expert assistance to make crucial choices in farming practices (An-Vo *et al.*, 2021). It is important that the data are findable, accessible, interoperable and reusable (FAIR) for the decision-making process and planning activities at different levels from farm, regional to national (Gacenga *et al.*, 2023). Agricultural datasets are diverse in terms of formats, range of capture data and standards due to the different repositories, stakeholder needs, and commercial interests (Runck *et al.*, 2022). Crop yields, phenology, pest incidence, and irrigation/fertilization data are critical inputs for decision support systems (DSS) (Kukar *et al.*, 2019). The online tools to date can assist in process and analysis to extract useful insights (An-Vo *et al.*, 2024) to optimize farm operations. Measuring and monitoring the performance and progress of the farm business, such as productivity levels, financial targets and environmental goals are keys to sustainable agriculture. Those who use and benefit from agricultural data are from government and business sectors, such as producers, buyers, research, institutions, advisors, and commercial sectors (Moot *et al.*, 2021). Users have different preferences and requirements for the type of data needed, how reliable, current, accessible, and precise the datasets are in both the public and private domain (Runck *et al.*, 2022). For instance, the livestock industry plays a crucial role in the beef product supply chain. Data which tracks paddock to plate is becoming increasingly vital for informed decision-making. Significant amounts of data are collected within cattle farms in Australia; however, a lack of suitable data-driven methods, means much of the data go to waste without being effectively used

(Duwalage *et al.*, 2023). In Australia, the AgReFed system is a cooperative of data provider communities which supports collaboration and insights in research through improving the discoverability of trusted, reusable, and analysis-ready agricultural research data. It enables researchers to discover datasets, workflows and models related to various aspects of agriculture. It also provides tools and training materials to help data providers and users to adhere to the FAIR principles of data management (Gacenga *et al.*, 2023). In New Zealand the AgYields National database (Moot *et al.*, 2021) provide a tool for farmers, rural professionals, and researchers to identify the most suitable pastures and crops for different districts and thereby help develop more resilient pasture and crop systems (Teixeira *et al.*, 2023; Teixeira, Olykan and Moot, 2023). In this review we compiled, compared, and summarized the status of the most recent database and online repositories tools which are available to support rural communities and the agricultural sector in Australia and New Zealand. We also outline the challenges and future developments which can be integrated into such databases.

Methods

Qualitative data

The qualitative data were gathered from the internet using non-probability sample method (Lamm and Lamm, 2019) and English key words in advance search query through Google and Google Scholar search (Gusenbauer and Haddaway, 2020). Accurate keywords and terms included: Database, Online Farm platform, Yield, Production, Harvest, Field trial results, Australia, and New Zealand. This list of websites and platforms was compiled between January and May 2023 and focused on agricultural production aspects in Australia and New Zealand. We then focused and compare the contents (2024) of two most recent online platforms: the [AgReFed](https://www.agrefed.org.au/) (Australia) and [AgYields](https://www.agyields.co.nz/) (New Zealand).

Results

Table 1 lists the primary agricultural platforms that support farming in Australia (9 data platforms) and New Zealand (7 platforms). They are the relevant online tools which can assist decision making.

Table 1. List of agriculture data platforms in Australia and New Zealand.

| Website | URL |
|--|---|
| Australia | |
| ABARES -Australian Bureau of Agricultural and Resource Economics and Sciences | https://www.agriculture.gov.au/abares |
| ABS - Australian Bureau of Statistics | https://www.abs.gov.au/ |
| AGREFED | https://www.agrefed.org.au/ |
| AGSURF - Australian agricultural and grazing industries survey (AAGIS) and Australian dairy industry survey (ADIS) | https://inform.regionalaustralia.org.au/data/item/agsurf |
| DCCEEW - Department of Climate Change, Energy, the Environment and Water | https://www.dcceew.gov.au/climate-change |
| GRDC Online Farm Trials | https://www.farmtrials.com.au/ |
| GrowNotes | https://grdc.com.au/resources-and-publications/grownotes |
| NVT - National Variety Trials | https://nvt.grdc.com.au/ |
| YGA - Yield Gap Australia | https://yieldgapaustralia.com.au/ |
| New Zealand | |
| Stats NZ-Tatauranga Aotearoa | https://www.stats.govt.nz/topics/agriculture |
| AgriBase | https://www.asurequality.com/services/agribase |
| National Vegetation Survey (NVS) databank | https://www.landcareresearch.co.nz/tools-and-resources/databases/ |
| Agricultural and Horticultural Statistics | https://www.mpi.govt.nz/science/open-data-and-forecasting |
| FAR – Foundation for Arable Research | https://www.far.org.nz/resources |
| MOTU | https://www.motu.nz/resources/datasets/ |
| On Farm | https://on-farmresearch.co.nz/library/ |
| AgYields National Database | https://www.agyields.co.nz/ |

Each platform serves different purposes within the agricultural research domain, varying on scale (from national to catchment or farm level) and purpose i.e. (economic, productivity, environmental). For instance, AgReFed (Australia) focuses on data discovery, analysis, and FAIRness. AgYields is specifically designed for collating plant species and growth rate data with reference information about data source, location (region and sites), soil type, basic management practices (i.e. irrigated vs. rainfed) and the dominant species at the site as base information (Table 2).

Table 2. A brief comparison between [AgReFed](https://www.agrefed.org.au/) and [AgYields](https://www.agyields.co.nz/) platforms.

| Item | AgReFed | AgYields |
|---------------------------|---|--|
| Location | Australia | New Zealand |
| Range of data services | Integration of websites, datasets workflows, models, virtual computing machines | Published and unpublished agricultural datasets for crop and pasture species |
| Access and navigation | Free | Free |
| Registration | Not required | Required |
| Dataset repository | No | Yes upload and download available |
| Meta data discoverability | Yes (registered websites) | Yes (literature and commercial reports) |
| Support and licensing | Australian Research Data Commons (ARDC) and the Australian Government | Creative commons; Lincoln University New Zealand Research Trusts, Seed companies |

AgReFed provides a cloud-based platform where researchers and anyone interested in Australian agriculture can access a wide range of federated, trusted, reusable agricultural datasets (listed in Table 1, Australia) workflows, models, and virtual computing machines.

A)



B)

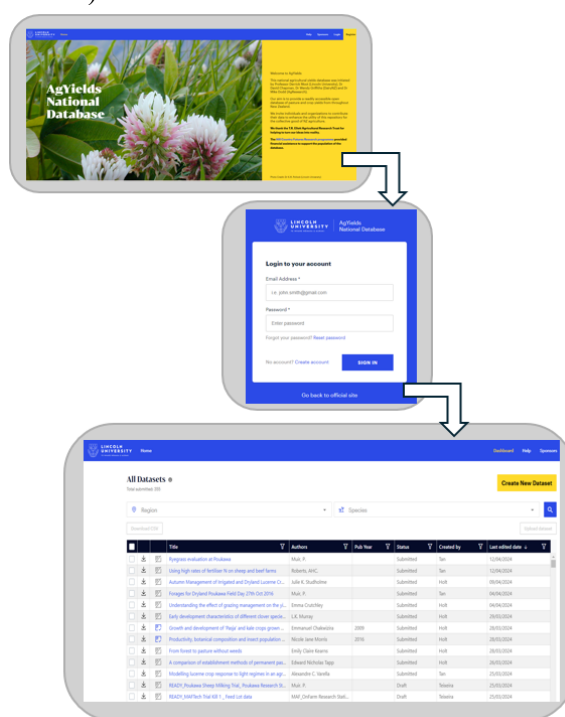


Figure 1. Agricultural data access using the (A) AgReFed platform (<https://www.agrefed.org.au/>) and (B) the AgYields National Database (<https://agyields.co.nz>)

By offering access to high-quality datasets, as shown in Figure 1-A, AgReFed empowers researchers to gain evidence-based insights to inform agricultural practices, policy decisions, and on-ground strategies (Agricultural Research Federation, 2021). The open access database AgYields National Database (Table 1 and Figure 1, B) is a repository of flowering dates, yield, and growth rates of different species in different locations in New Zealand. Once formatted for a given study, specific treatments (i.e. fertilizer levels, species/cultivars, sowing date) from that study can be included. The compulsory data required are from successive measurements (to enable a time interval to be calculated) of either (i) yield (biomass and grain, i.e. kg DM/ha) or (ii) growth rate (kg DM/ha/day and (iii) flowering date. These can be used to inform other decision support tools such as FARMMAX.

Conclusion

AgReFed platform and the AgYields National database provide the opportunity to advance agricultural research and on-farm decision making. These database platforms are catalysts for progress, connecting researchers, practitioners, and policymakers in a shared pursuit of agricultural excellence. The AgReFed platform aims to facilitate data access by transforming how agricultural researchers collect, describe, and disseminate their findings. Multidisciplinary researchers, local and federal government, research

organizations, and farmers' organizations will benefit from the project's core features. AgYields aims to standardize data collection practices, ensuring consistency and reliability. As the database evolves, it will continue to be a valuable resource for New Zealand's livestock and crop production systems. Guidelines for data collection and the establishment of best practices benefit hill country farmers, professionals, and researchers alike. By centralizing information, databases facilitate collaboration, reduce redundancy, and accelerate scientific progress. As the platforms evolve, allowing for cost-effective storage of large amounts of data they ensure, and information remain relevant and valuable to the agricultural community.

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