Enabling Digital Agriculture in Australia

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The Australian agricultural sector is on the brink of major change, with the transition to digital business and production models creating significant challenges and opportunities. Australia has led the world in the development and implementation of advanced agricultural technologies; yet despite our innovative culture, our agtech market is in its comparative infancy. While deriving benefit from global examples of big data and digital adoption, Australian production systems face some unique challenges that require home-grown solutions. Many Australian producers and agricultural stakeholders also lack trust in data management systems and require improved digital knowledge. They are frustrated by telecommunications connectivity shortfalls and the inadequacy of services supporting adoption. The volume of data gathered is increasing exponentially, but this is of little value unless it can be used to improve on-farm profitability by enabling better management decisions. A lack of producer control and under-utilisation of data are putting Australian agriculture at a global disadvantage. A detailed analysis of how Australian agricultural stakeholders can capture value from their data was undertaken in the Accelerating Precision Agriculture to Decision Agriculture (P2D) project, which evaluated the current state of digital agriculture in Australia, modelled the potential economic benefits and made recommendations to realise these gains at the farm gate. This project is believed to be the first time globally that an entire industry sector has taken a national, coordinated approach to tackle issues associated with digital transformation.

Australia has been a world-leading player in the development and use of advanced agricultural technologies such as precision agriculture. For example, agricultural industry adoption of auto-steer technology is the highest in the world (Llewellyn & Ouzman 2014). Despite our innovative culture, the Australian agtech market is in its infancy compared to countries such as the United States of America (US) and Israel (Perrett et al. 2017). Australian agriculture is on the brink of major change as we enter a new era of digital agriculture. The transition from analogue to digital business and production models is creating challenges and opportunities across all industry sectors, domestically and internationally. Agriculture is not immune from this change.

Information and communication technology (ICT) and automation spillover from overseas is occurring in some industries including cropping, dairy and intensive livestock. However, Australian production systems face some unique challenges that require home-grown solutions to enable appropriate data-based decision making.

Many Australian producers are finding it difficult to navigate the digital agricultural marketplace and worry about unwise investments without a guarantee of return. Producers lack trust in data management systems, access by third parties and are unclear about the terms that govern their data including who owns their data. Many producers and agricultural stakeholders require improved digital skills and knowledge and are frustrated by the unreliability of telecommunications connectivity and the inadequate services currently supporting the adoption of digital technology.

The value placed on data and technology varies between agricultural industries, but producers are becoming more skilled at deploying precision agriculture (PA) technologies. The volume of data gathered from farm machinery, sensors and digital technologies is increasing exponentially.

Increased temporal and spatial information about the status of soil, water, crops, animals and pasture etc, is of little value unless it can be used to make and action improved decisions. How to use this data to improve on-farm profitability often remains the challenge. A lack of producer control and under-utilisation of data to make decisions are putting Australian agriculture at a global disadvantage. Australia clearly cannot afford to be left behind.

The Australian agricultural sector has undertaken a detailed analysis of what digital agriculture means for Australia and what needs to be done for Australian producers to capture value from their data in the Accelerating Precision Agriculture to Decision Agriculture (P2D) research project. The P2D project was funded via the Australian Government Department of Agriculture and Water Resources Rural R&D for Profit program and all 15 Research and Development Corporations (RDCs).

The P2D project has evaluated the current state of digital agriculture in Australia, modelled the potential future economic benefits and makes recommendations to realise these potential economic gains at the farm gate. This project is believed to be the first time globally that an entire industry sector has taken a national, coordinated approach to tackle issues associated with digital transformation.

This special edition *Farm Policy Journal* has summarised the P2D project findings and recommendations.

Summary of Key Findings

The future state

With maturity, the economic modelling identified that the implementation of digital agriculture across all Australian production sectors (as represented by the 15 RDCs) could lift the gross value of agricultural (including forestry, and fisheries and aquaculture) production by $20.3 billion; a 25% increase on 2014–15 levels (Perrett et al. 2017). Four areas are highlighted where cross-sectoral collaboration could unlock over $1 billion of economic benefits: automation and labour savings, $7.4 billion (eg machinery, animal handling and product processing); genetic gains through objective data, $2.9 billion (eg animal and variety selection); tailoring inputs to need, $2.3 billion (eg fertiliser seed, and water), and market access and biosecurity, $1 billion (eg pest and disease control) (Table 1).

Table 1: Summary of potential unconstrained impact of digital agriculture to gross value of production (GVP).

Sector	Potential estimated benefit to the economy
	GVP[a] Increase (%)
Rice	30
Grains[b]	51
Cotton	28
Sugar	23
Horticulture[c]	40
Beef	16
Sheep meat	17
Wool	18
Pork	5
Dairy	15
Eggs	25
Chicken meat	24
Wine	12
Forest and wood products	37
Livestock exports	4
Red meat processing	14
Fisheries and aquaculture	44
Total	**25**

a GVP measures the actual production output of an establishment or sector.

b Including oilseeds and pulses.

c Leafy greens, brassicas, and carrots only.

The current state

Today, digital agriculture in Australia is in an immature state. It's important to recognise this is not a unique state to just the agricultural sector, or this country, although Australia is behind countries like US. The study rates the digital maturity of the Australian agricultural sector as 'ad hoc', highlighting issues of leadership, value proposition,

trust and legal barriers, connectivity availability of appropriate data, digital literacy, data analysis and decision support tools. The Australian market for digital agriculture products and services is in its relative infancy compared to the scale and pace of developments occurring in other parts of the world. However, the full economic potential of digital agriculture will struggle to be realised until there is a data management policy that sets out principles on data management.

A common cross-industry need for greater leadership in digital agriculture was identified. Cross-industry collaboration is required for digital agriculture policy, governance and strategy development and implementation as currently, the legal and regulatory frameworks around agriculture data are fragmented, piecemeal and ad hoc (Wiseman & Sanderson 2017). When surveyed for the P2D project, 56% of producers indicated having no trust or little trust in service and technology providers maintaining their data privacy or not sharing their data with third parties (Zhang et al. 2017). Robust guiding policy at a national scale is required. Australian producers want to know that their data is adequately protected and used fairly.

Implementing a data management code of practice and certification or accreditation would provide mechanisms to increase transparency and trust. One way this could be achieved is by developing trust and greater transparency about the terms of use that govern the collection, aggregation, ownership, storage and dissemination of data. This trust and transparency are essential prior to producers entering into commercial relationships with third-party advisers and technology service providers.

Producers indicated the value of adopting digital agriculture is not yet clear. Value was not only related to monetary value, but also peace of mind, confidence, social and lifestyle factors. If digital agriculture is to be adopted, it needs to be sustained by consistency of service and support and the reliability of technology (Skinner et al. 2017). A lack of access to mobile and internet telecommunications infrastructure is a major impediment to the adoption of digital agriculture systems (Lamb 2017). This is costing producers, agribusinesses and the Australian economy billions of dollars each year in terms of lost productivity – and profitability. While lack of connectivity is only one of the five constraints to the progression to digital agriculture, connectivity is considered the engine. Without connectivity, digital agriculture is not possible. The project survey highlights the difficulties related to the reliability of the current mobile phone network: 55% of producers used the mobile phone network for internet, yet 43% had patchy or no mobile reception across their property (Zhang et al. 2017). An improved understanding of producers' data needs and servicing these needs is required (Lamb 2017).

The whole agriculture value chain, irrespective of industry sector, could gain from improved access and interoperability of stored data through dissemination of data sets that are valuable across the rural sector that are also widely used in other industries (Barry et al. 2017). Many of the producers and supply chain organisations that participated in the regional stakeholder workshops commented that they 'struggled to access and integrate data'.

The standardisation of data formats would introduce interoperability benefits both for users and developers. Within the international agricultural sector, access to open data sets has been proven to accelerate the availability and adoption of digital agriculture solutions. However, much of the data resulting from publicly funded research activities in Australia is not made available for common use. Public/private investment models would need to support integration of corporate data into foundational data sets and the improved accessibility of data gathered by government bodies to the corporate sector.

A digital skills and capability gap was identified across the value chain. It was identified that education support was not only required to upskill the agricultural sectors but also to generate more data scientists and engage them with agriculture (Skinner et al. 2017). While the breakdown of data maturity by industry shows some maturity, the approach to deploying big data solutions across the agricultural sector is uncoordinated and

ad hoc. A big data reference architecture provides a common starting point for digital agriculture systems (Skinner et al. 2017).

Key Recommendations

This summary report brings together the key findings and aggregates the 67 detailed recommendations into 13 key recommendations to the agricultural sector to realise the potential economic gains of digital agriculture in five areas: policy, strategy, leadership, digital literacy and investment.

Policy

1. **Develop a Data Management Policy for Australian Digital Agriculture.**
2. **Develop a voluntary Data Management Code of Practice and a Data Management Certification or Accreditation Scheme.**
3. **Policy and investment to improve telecommunications to farms and rural businesses.**
4. **New investment models including public/ private investment.**

One of the first steps for industry in implementing good data management procedures is to establish a national data management policy. This is a set of broad, high level principles that will form the guiding framework in which data access and management can operate. More specifically, a data management policy for Australian digital agriculture must consider issues such as data custodianship and access, data collection and storage, data harmonisation and standardisation, data stewardship, data security, data portability, data lifecycle management and data audits.

By addressing the constraints identified in the P2D project, this policy will support both the adoption of existing digital agriculture technologies and practices, as well as facilitate the emergence of new business models and their associated products and services. In addition, a data management policy for Australian agriculture will help ensure that the full economic and social potential of decision agriculture will be achieved.

Currently, all 15 RDCs fund projects within their respective industries without cross-industry collaboration or the requirement for leveraging similar research carried out in other industry sectors. This represents a significant cost duplication to levy payers. A consolidated approach to digital agriculture would provide an opportunity for RDCs to collaborate and find new and efficient ways to consolidate, analyse and act upon data at a whole-of-industry scale.

At the heart of digital agriculture are telecommunications connectivity and data analysis, leading to better informed decision making and implementation.

Strategy

5. **RDCs develop Digital Agriculture Strategies and Implementation Roadmap.**
6. **Big Data Reference Architecture and Data Management Implementation Plan.**
7. **Establish, review and refine foundational data sets.**

There is an absence of clear digital strategies within the RDCs, evident from interviews and observations gathered during the P2D project, indicating that the RDCs lack a clear roadmap for the adoption of digital agriculture.

Leadership

8. **Establish a Digital Agriculture Taskforce for Australia headed by the Chief Digital Agricultural Officer – to deliver outcomes.**
9. **Establish a Digital Agriculture Taskforce for Australia Working Group – to provide guidance.**

Interviews with the RDCs identified a lack of technical leadership within industry organisations from a national to a community level. To address this, a Digital Agriculture Taskforce for Australia (DATA) – staffed by a small cross-industry team of data scientists, technologists and legal experts – would have the broad objectives of:

- identifying and initiating collaborative data opportunities

- building foundational data sets
- developing and supporting implementation of a cross-industry digital agricultural strategy
- refining and growing a Big Data Reference Architecture
- monitoring and guiding telecommunications and connectivity
- developing data science capability.

A Digital Agriculture Taskforce for Australia Working Group (DATAWG) should be established to drive the policy and investment required to advance digital agriculture in Australia. The group would consist of representatives from the 15 RDCs, relevant industry experts, government, peak industry and commercial representative bodies.

Digital literacy

10. Provide education and capacity building to increase digital literacy in the agricultural sector.

There is a need, both in the research and development (R&D) sector and in industry, for people with digital skills who also understand the agricultural sector. Evidence from the regional stakeholder workshops indicates that the Australian university system is not producing sufficient agronomists with the required skills, and that current incentives to improve this situation are insufficient. Education and training are required at all levels within the industry to increase knowledge and understanding of connectivity options, best practice in data management and use and data licensing. New programs should also be developed to provide the relevant skills to the emerging agricultural workforce that will be required to progress decision agriculture.

A review of the skills required by producers to maximise the benefits derived from digital agriculture is recommended to provide a foundation for the development of educational packages. The establishment of demonstrator sites could be considered to enable producers gain first-hand experience of innovations and best practice in data management in a practical environment. Skill gaps have already been identified in the areas of on-farm telecommunications and data science, but a more comprehensive analysis is required.

Enablers

11. Establish baseline patterns of data usage and a national mobile network coverage (data speed and volume) database.

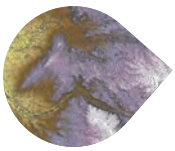
12. Digitise and automate data collection including for regulatory compliance activities.

13. Execute a cross-industry survey every three years to identify producers' needs and issues in digital agriculture.

The technologies, enabling functions and many data sets that support digital agriculture are not sector-specific. The commonality of issues reinforces the need for cross-sectoral collaboration to produce uniform policy in areas that will facilitate the unconstrained implementation of digital agriculture.

Conclusions

To achieve maturity, cross-industry and cross-sector collaboration is vital as many of the issues impeding maturity are common, and this scale of investment is required to implement solutions for Australian conditions and to keep pace with the rest of the world.



The P2D project has detailed a clear value proposition and pathway forward for transformational improvement in Australian farm business management and decision making through digital agriculture. For this potential to be realised, it is essential for industry, RDCs, government and the commercial sector to work together.

The recommended next steps are for all RDCs to co-invest in the recommendations with the Australian Government and to support the establishment of DATA and DATAWG. The next steps in delivery of a successful digital agriculture program will enable Australian agriculture to remain internationally competitive and at the forefront of best practice for production, environment and community benefit.

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