



FELLOWSHIP SUMMARY REPORT

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Science and Technology Branch, Agriculture and Agri-Food Canada (AAFC)**

**Considerations for Canada's National Data Strategy:
Big Data in Agriculture in Canada and Australia**

OECD Co-operative Research Programme

Theme 3 (Transformational Technologies and Innovation (Precision Agriculture))

Host institution:

Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)
Australian Department of Agriculture

Host Collaborator/s:

Steve Hatfield-Dodds (Executive Director), John Sims (Principal Scientist)

Dates:

25 October – 29 November, 2019



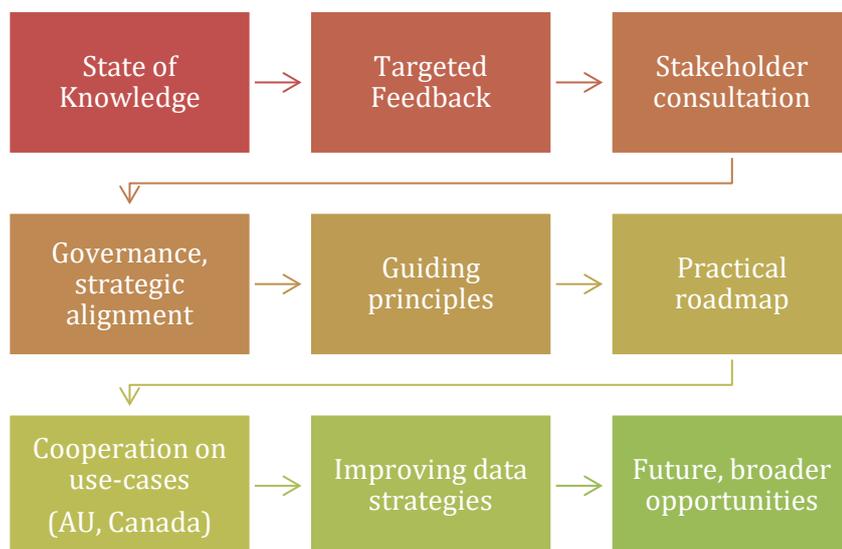
1. What were the objectives of the research project? Why is the research project important?

The broad objective of this research project is to strengthen scientific knowledge in big data in the agricultural sector through the integration of relevant scientific information, and scientific and policy advice into a novel set of principles and a prototype national big data framework for Canada, Australia and potentially other OECD member countries. The specific project objectives were to:

- 1) **Identify and synthesize reported survey information/available data** from Australia obtained through consultation on the benefits and use of big data from a range of experts with differing perspectives, knowledge, and stakeholder roles (i.e., government public sector, agricultural organizations, agribusiness/private sector).
- 2) **Compare and contrast the emerging benefits, uses, and barriers to big data** and its five core aspects (Volume, Variety, Velocity, Variability, Veracity, and Value) from both the Australian and Canadian contexts/situations. This will also address ways to foster private-public partnerships while addressing trade-offs among data availability, ownership, value, incentives for sharing, and privacy.
- 3) **Devise set of guiding (governance) principles** that follow “FAIR” – finable, accessible, interoperable, and reusable – aspects that need to be maintained as standards for agricultural datasets for academia, industry, and government.
- 4) **Consult with ABARES experts in designing/developing a strategic framework** for the flow of big data within the government/public sector from data generation to the formation of actionable insights spanning: data generation, integration, processing/management, analysis, actionable insights (science and policy). This framework should consider the needs and challenges for ensuring a robust infrastructure that houses and provides open access to publicly funded datasets.
- 5) **Develop a collaborative ‘future-looking’ workforce plan** (Australia and Canada) for: i) public service training courses to increase knowledge in managing, analysing, and manipulating large, complex datasets, and ii) developing a culture that better supports and rewards scientific communities/researchers to build off one another’s datasets, standardize protocols, harmonize experimental designs, and ensure that datasets can be usable over the long-term to minimize the number of orphan datasets.
- 6) **Build and deliver a collaborative presentation** to communicate benefits, uses, and challenges of big data in agriculture.

2. Were the objectives of the fellowship achieved?

During the course of the fellowship visit, all the objectives listed above were achieved. The presentation (objective 6) was delivered at ABARES with stakeholders from the Australian Bureau of Statistics (ABS) also in attendance. A range of data and subject-matter (e.g., ecosystem/land accounting, official statistics, biosecurity, fisheries management) experts in Canada and Australia were consulted. They provided information and details on current data types, governance, and applications. Also, a synthesis of information available from the peer-reviewed scientific literature and relevant Canadian and Australian governmental reports was completed. Information and details are being compiled into a draft version of a white-paper for Agriculture and Agri-Food Canada (AAFC). Within the next few months, following the fellowship visit, feedback will be solicited from reviewers and AAFC policy collaborators to revise and finalise the white paper. Further in-depth discussions with AAFC’s Strategic Policy Branch will be undertaken on key aspects of workforce planning and development (objective 5).



Overview of steps involved in the CRP fellowship project in big data.

3. What were the major achievements of the fellowship?

a) The fellowship involved undertaking a synthesis of latest knowledge and information on big data from a broad range of sources, including scientific and non-scientific/grey literature sources, and feedback from stakeholders. This enabled the design of a comprehensive and strategic governance framework for big data based on current organizational alignment and latest considerations (from the Australian and Canadian context and perspective). This framework will serve as a benchmark for organizations to compare and contrast their use and interaction with big data in terms of seeking benefits, and addressing barriers and opportunities. As progress continues, organizational alignment will continue to change, adapt, and evolve in terms of their increasing use and interaction with big data.

b) The fellowship also produced an outline and development of a white paper for advising AAFC/Government of Canada on big data governance. Evidence and insights from the study help to support AAFC's departmental data strategy and Canada's national data strategy implementation. Two targeted publications stemming from the study will also help to inform the broader scientific and government policy communities on big data governance needs, gaps and uncertainties, while informing agricultural stakeholders of its current and future benefits and opportunities within the digital economy.

c) Several areas for potential collaboration between Canada/AAFC and Australia/ABARES were identified:

Agricultural Risk Management

- a. Biosecurity
- b. Weather index-based multi-peril crop insurance

Precision Agriculture and ICT (Living Laboratories / Smart Farms)

- c. Integrated smart-farm design with AI model guidance (IP, patentable, deployable)
- d. Best-management practices (BMPs) extreme weather events, crop diversification, climate adaptation
- e. Farm Sustainability, economics, environment, social



Prediction Analytics – Integration of Business intelligence and Strategic Foresight

- f. Seasonal forecasting of pest/disease risk using climate/weather data
- g. Land-use accounting: cropland suitability and productivity
- h. Reducing bias in official agricultural statistics

4. Will there be any follow-up work?

Two publications stemming from the fellowship study are envisaged in 2020. The first is a collaborative manuscript (perspective article), written with some additional research work in 2020, on “Big data governance: benefits, gaps, and challenges” for an international journal (e.g., *Frontiers in Big Data*; Section on Data Mining and Management). The second potential publication is a chapter contribution (10,000 words) on the role of big data and data governance to enhance agricultural (and rural resilience) (chapter entitled, “Big data governance, technology, and implementation in climate resilient societies”). The aim is to complete and submit by August 2020, but the official submission deadline for contributions is July 2021. For this later contribution, communication has already been made with Robert Brears, Editor-in-Chief of a major reference work to be published by Palgrave Macmillan, Springer Nature entitled, “Climate Resilient Societies”).

See: <https://meteor.springer.com/project/dashboard.jsf?id=972&tab>About&mode=ReadPage&entity=7408>

The fellowship is likely to start collaboration between the home institution (AAFC), the host (ABARES) and the Australian Bureau of Statistics (ABS) as several new areas of collaboration were identified and discussed during the fellowship stay involving the use of satellite Earth observational data and Australian governmental administrative big data.

The research has produced a novel strategic framework/methodological design for big data governance, enhanced guiding principles, and developed new insights for real-world big data agricultural-sector applications and use-cases. Further collaborative work spawned from the fellowship will likely produce new methodological designs/models, integrated big datasets, and open source computer code.

5. How might the results of your research project be important for helping develop regional, national or international agro-food, fisheries or forestry policies and, or practices, or be beneficial for society?

Big data is a general term for massive amounts of digital data collected from all sorts of sources that are too large, raw, or unstructured for analysis using conventional relational database or statistical techniques. Applying big data to Canada’s primary industries (e.g. agriculture) has the potential to lower economic costs, reduce environmental impacts and improve human health with less food waste, harmful greenhouse gas emissions, reduced land disturbance, and better biosecurity/food safety, while creating valued added benefits within a rapidly expanding new digital economy. Combining big data with modern machine learning enables doing more with less, finding overlooked opportunities, and new improvements that are not obvious to humans. In turn, our big data will continue to offer new commercial and public good opportunities on a path forward towards a sustainable, inclusive, peaceful future, in the face of escalating environmental and socio-economic changes and risks, and uncertainty.

The fellowship research work involved synthesizing, comparing, and contrasting the latest knowledge, perspectives, principles, lessons-learned, organizational alignment, and insights as a crucial step in building and implementing effective and robust big data governance strategies and frameworks. The project findings will increase awareness and inform academia, government (science and policy), agricultural industry, and the public on big data governance benefits, challenges, and future opportunities. We may not be able to achieve the UN’s Sustainable Development Goals (SDGs) without the use and integration of big data as a frontier technology as it is crucial to building awareness on the evolving state of our planet, influencing consumer behaviour, informing economic markets, and reforming governance systems. The findings from this fellowship will contribute to informed, evidence-based guidance on how to harness big data strategies and digital platforms as an accountability mechanism for achieving the UN’s SDGs. Benefits, challenges, and



complex use-cases can be better understood and realized from different operating national and regional context and current capability.

The quote below expresses well how big data is beneficial for society:

“Global environmental data, technologies, and data science techniques have the potential to create insights that can underpin a sustainable future and profoundly transform our relationship to the planet. These include satellites and drones, cloud computing, artificial intelligence, the internet of things, block chain, citizen science and a range of open source software and mobile phone applications. But how to harness these technologies for sustainability?”

Work on Big Data gets a Big Boost, Big Data News –Second Global Session of the United Nations (UN) Science Policy Business Forum and UN Environmental Assembly (UNEA) (April 10, 2019). <https://un-spbf.org/big-data/work-on-big-data-gets-a-big-boost/>

6. How was this research relevant to the objectives of the CRP? The CRP research theme?

The research study met all three core objectives of the Co-operative Research Programme (CRP) by:

- 1) Strengthening scientific knowledge, exchanging ideas, and increasing mobility and cooperation in big data between AAFC/Canada and ABARES/Australia
- 2) Providing relevant scientific information to support big data governance and policy development for improved sustainable use of natural resources
- 3) Integrating and promoting social, economic and environmental benefits and opportunities linked with more effective big data governance and use for improving economic and social well-being.

Big data is crucial to supporting precision agriculture, a key objective of the CRP's Theme 3: Transformational technologies and innovation, through more effective data governance, sharing, and use of data to enable existing and new information and communication technologies (ICT) for optimizing crop growth and production while minimizing harmful environmental impacts. Big data is considered to have an increasing role in GPS, spatial mapping, equipment guidance, and robotics guided by machine learning/artificial intelligence algorithms. Big data is a transformational or frontier technology for transforming agriculture to be more productive, sustainable and resilient.

The research study interfaces with previous and current work conducted by the OECD on big data, namely: Data governance/Enhancing access to and sharing of data (2015), Big data – bringing competition policy to the digital era (2016), Data-driven Innovation (DII) - Big data for growth and well-being, OECD Digital Economy Outlook (2017), and Measuring the Digital Transformation –a roadmap for the future (2019).

7. Satisfaction

The fellowship fully met my expectations. It expanded my professional network and opened up new collaborative research opportunities. It enabled me to demonstrate leadership in innovation at the international level – an important element of career development and progression for research scientists. No practical problems were encountered, despite the need to change fellowship activity dates. I thank the OECD CRP program for approving the change of activity dates.

I am very thankful for all the helpful information, advice and support during my fellowship to ABARES/Australia co-operators and collaborators, namely: Steve Hatfield-Dodds (Executive Director), John Sims (Senior Principal Scientist and Program Leader for Research Information Systems), Joanne Sullivan



(Corporate Data Manager), Neil Thompson (Assistant Director, Information Systems), and collaborators in AAFC's Strategic Policy Branch (SPB)/Canada, namely: Alison Kinsman (Data Policy Analyst, Data Development and Partnerships), and AAFC's Science and Technology Branch (STB)/Canada, namely: Christine Bissonnette (Policy Analyst, International Engagement Division) and Anne-Michelle Bareil (Deputy Director, Science Policy Integration). Helpful information on organizations involved in big data and investment information that was provided by Mr. Amit Khaira of the Australian Trade and Investment Commission (Austrade, Australian Consulate, Vancouver, Canada) was also very helpful. I would also like to recognize the helpful advice, information, and feedback provided by the many academia, government, and industry big data stakeholders that were consulted in this study.

8. Advertising the Co-operative Research Programme

I learned of the Co-operative Research Programme (CRP) through my government department. In addition to former OECD CRP fellows communicating and informing others on this program, I would suggest some programme representatives produce an information webinar/video presentation that could be shared online via social media and the internet which could better inform scientific research organizations on the benefits of this program.

I recommend, where possible, establishing some linkage of the activity of fellows to relevant people or groups conducting similar or related work within the OECD. This might offer additional support and enhanced opportunities for visibility of the CRP program within the larger OECD community. It could also provide additional advice, guidance, and support for fellows when conducting their work, as well as increase the visibility of their work within their respective participating organizations.