THE UNIVERSITY of ADELAIDE

Mr Rick Wilson MP
Chair, Standing Committee on Agriculture and Water Resources
PO Box 6021
Parliament House
CANBERRA ACT 2600

14 October 2019

Dear Mr Wilson

Submission to House Standing Committee on Agriculture and Water Resources

Please find below a submission from the University of Adelaide to the House Standing Committee on Agriculture and Water Resources inquiry into growing Australian agriculture to $100 billion by 2030.

This submission identifies current sector opportunities and impediments, we articulate the important role the University has played and continues to play in the development of agriculture in Australia, and, as such, we propose that the University is well placed to help drive the next wave of innovation required by the agriculture sector to meet the challenges ahead.

The University advocates that evolution to a bigger industry requires substantial investment in fundamental research and an uplift in industry-university interactions to stimulate innovation and rapid translation. We believe that it is only through greater technological integration and innovation spanning the entire agriculture, food and wine food value chain, delivered through larger scale collaboration, that we will be able to deliver a step-change in productivity and reach the $100 billion target by 2030.

We conclude our submission by outlining a proposed *Mission for Future Crop and Community Resilience,* to be developed in partnership with other universities and industry that we believe could perform a critical role in delivering on the espoused growth target.

Yours sincerely

[redacted]

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Provost and Deputy Vice-Chancellor (Research)

cc:

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House Standing Committee on Agriculture and Water Resources inquiry into growing Australian agriculture to $100 billion by 2030

Submission – The University of Adelaide

Introduction

The University of Adelaide has a distinguished 135-year history of research and education in agriculture, food and wine. We operate two dedicated agricultural campuses and a working farm; both campuses run a co-location model with industry and government partners, and are innovation hubs that link the training, research, development and translation essential for sector transformation.

The University of Adelaide's Roseworthy campus is renowned for excellence in dryland agriculture, natural resource management and animal health and production – its goal is to improve cattle genetics, welfare and meat quality, whilst reducing the environmental footprint of livestock farming. The University's Waite campus has the largest concentration of expertise in the southern hemisphere in wine and crop-based agricultural sciences, and is globally recognised for its strengths in agronomy, plant science, fertiliser technology, breeding, landscape and soil science, winemaking, viticulture, and food research. The Waite conducts more than 70% of the nation's wine research, is the origin of the majority of the dominant cereal varieties over decades, and has successfully transitioned several of its breeding programs to commercialisation – notably through the remarkably successful plant breeding company, Australian Grain Technologies.

The University of Adelaide's city campus houses the Centre for Global Food and Resources, which conducts multidisciplinary (policy, economics, business) research into achieving healthy, resilient and productive communities and landscapes that are food, water and resource secure. Additionally, the Food Values Research Group uses qualitative and other research approaches to understand how people make everyday food choices, and how their 'thinking frameworks' are shaped socially, culturally and historically.

The University also employs an interdisciplinary approach to agricultural research. Currently a new wave of engineering, data science and mathematical capabilities are being deployed into agricultural research in order to capitalise upon the translational skill sets that have been successfully applied across the defence, minerals, energy, remote sensing, and water sectors.

As an indication of the quality of these University disciplines, in the 2018 Excellence in Research for Australia exercise, our Agricultural, Mathematics and Engineering research outputs were all rated as 5 'well above world standard', and our engagement and impact assessments were similarly ranked. By partnering with industry in these endeavours we are targeting improvements in the commercial prospects of Australian agribusiness, to grow industry profitability and sustainability in the face of a plethora of challenges.

The University is also dedicated to educating the next generation of sector graduates and evolve the current workforce through diverse educational offerings across the agriculture, food and wine sector, from standard degree programs to continuing education. We ensure that offerings are developed with industry input and that students are exposed to industry practice through work integrated learning opportunities with hundreds of industry partners. The number of students commencing the University's Bachelor of Agriculture Sciences degree has doubled in size between 2014 and 2019. Within three months of graduation, 91% of our graduates have an employment outcome in the industry. After consultation with industry, and to fill an emerging skills gap, we are continuing to grow the University's postgraduate courses, whilst creating new Continuing Professional Development courses; and we are integrating the latest technology developments (big data, precision agriculture, advanced breeding) into our all our offerings.

Our priorities

The University of Adelaide's Strategic Plan, *Future Making*, identifies agrifood and wine as a critical research and engagement pillar. Our mission is to tackle the global challenges of food security and environmental sustainability in the Australian context. Our domain knowledge, capability and infrastructure facilitates the deployment of large scale transdisciplinary research programs to transform the Australian agrifood and wine sector.

We believe Australia is well-placed to enhance its position as a leader in agrifood and wine innovation. In order to meet the needs of Australian agribusiness we see it as imperative that research programs have a strong industry involvement and include a range of new training and engagement initiatives. By working in close partnership with industry we are:

- Further developing long-term partnerships between university, industry and government
- Meeting the skills challenge facing a transforming industry
- Forming translational research partnerships that deliver commercial benefits to industry.

Current sector opportunities and impediments

Australian agriculture is at the cusp of a complex suite of opportunities and challenges, which are well documented. In summary:

- Agricultural productivity growth has plateaued at ~0.5-1.0% p.a., well below the 2-3% needed in order to meet the challenges ahead.
- Population growth is placing pressures on global food security (the gap between demand and supply of food and resources).
- A rising middle class in Asia is a key market opportunity, but only if we can match our production, product mix and marketing to the needs of these markets.
- Climate volatility and change is a key risk factor for many farmers, who need better tools to forecast seasonal weather patterns and to manage their assets optimally.
- The impact of food production on the environment needs to be addressed, including reducing greenhouse gas emissions and food waste in both production and manufacturing.
- Increasing global competition is weighing on margins in the value chain, and producers and distributers need to capture more value through better marketing, food assurance and identifying high value customers.
- Market volatility means agribusinesses need to be more agile and market aware.
- Consumer demands are changing and evolving, including choice and food safety, a social licence for production, and changing public attitudes toward ethics and sustainability.
- There is increasing demand for higher quality and traceability of food in the global marketplace.
- There is need to better understand the relationship between food, human health and dietary disease, so that we can produce the next wave of functional and healthy foods.
- It is essential that workforce capacity issues be addressed at all industry levels including an aging cohort of farmers, an undersupply of graduates for skilled positions, and a shortage of seasonal labour.

Realising the ambition to reach $100 billion value of production by 2030

Australia needs to take advantage of the growing demand for safe, healthy food and the opportunities for transforming the agriculture and food industries through advanced technologies. The future competitiveness of agriculture will be as reliant on improvements in automation and digital agriculture as it is on genetic improvements and water use. We need to be cognisant of opportunities for carbon neutral or carbon capture in agriculture, and the innovations needed to drive this. Furthermore, manufacturing, value-adding and understanding consumer behaviour will become increasingly important components that drive growth.

It has been estimated that the global market for digital agricultural technology will increase to $240 billion over the next five years. In 2013 the market for agricultural robots alone was $817 million. This is projected to reach $16.3 billion by 2020. Goldman Sachs identifies a tech-driven improvement in agricultural yields of 70% by 2050. Technology for Australian farmers will be a key component of achieving a $100 billion agricultural industry, but should be an exporting industry in its own right. The Australian Institute for Machine Learning (AIML), ranked third in the world in aspects of computer vision, is a key capability provider in this area, and contributes to multi-disciplinary teams in applying computer vision and machine learning to the wine and grains industry. AIML, with more than 100 researchers, is the largest university-based research group in machine learning in Australia.

In order to fully capitalise on potential productivity gains, digital and engineering solutions need to be married to the latest innovations in crop and animal sciences. In particular, the deployment of genomic selection in breeding, gene editing and the judicious use of GM. The proposed changes in the regulatory environment for genetically modified crops creates an opportunity for a new wave of crops that are more tolerant to Australian conditions and climate volatility. Coupling these developments with advances in agronomy and AgTech will be necessary for Australia to meet the required 2-3% p.a. productivity gain.

What the University of Adelaide offers

The University is committed to building on our traditional strengths in plant and animal science, and additionally bringing to bear other strengths in machine learning and social sciences/policy and emerging strengths in AgTech to find disruptive technology solutions for agricultural production. We will continue to support the development of new products and related services, to deliver economic benefit. The translation of research and education into economic and social outcomes will be supported through the development of new partnerships with key stakeholders and enhancing relationships with existing partners, including leverage of the food innovation ecosystem.

We have developed a series of broad research platforms to deliver solutions for industry:

- robotic vision, sensing and machine automation, and advanced phenotyping;
- operations research (data science, machine learning and decision optimisation) and artificial intelligence;
- bioprocess engineering including food waste valorisation;
- crop and animal transformation facilities, and advanced multi-omic analysis;
- ethical, economic, environmental and policy analysis of proposed solutions to ensure their suitability to build further resilience into our agricultural industry and communities.

Together these platforms deliver a unique combination of multidisciplinary capabilities aimed at providing the agriculture, food and wine sectors with research discoveries that deliver major translational outcomes. We are developing a business case to use our working University farm as a showcase for what farming must look like in 2030; to be profitable and sustainable in a changing climate, along with a network of other sites across the state where technologies are developed and deployed in partnership with industry to facilitate sector adoption.

A collaborative approach

The University of Adelaide has a strong history of partnering with other institutions to ensure its food-related investigations meet real world needs and deliver a smooth, lab-to-plate transition of benefits. In addition to working closely with key food industry groups and government, the University invests considerable time and resources in focused research partnerships with more than 30 major companies and not-for-profit organisations. These range from international giants such as Pfizer, Nestle and Unilever, to national leaders, including Woolworths, Elders, Coles and Westpac, and local icons, like Haighs, Coopers Brewery and Thomas Foods.

Innovation, entrepreneurship and creative thinking is supported through Thinclab (and Thinclab Waite) – the University's innovation hub – aimed at giving locally based start-up companies the best opportunities to succeed and grow. Our academic staff work closely with food producers, processors and industry to ensure their innovations are ready for commercialisation. We partner with other universities and leading researchers in organisations such as the CSIRO and the SA Research and Development Institute (SARDI). The ARC Industrial Transformation Research Hub for Wheat in a Hot and Dry Climate (WheatHub) is a partnership between the University of Adelaide, UniSA and the University of Sydney along with the GRDC and Australia's three largest wheat breeding companies to enhance productivity and secure high grain quality of wheat. We partner with Charles Sturt University, the CSIRO, the Australian Wine Research Institute and 10 other industry partners to investigate aspects of viticultural management and the winemaking process through the ARC Training Centre for Innovative Wine Production.

Highly productive research partnerships also exist between the University of Adelaide and the University of Western Australia, Australian National University, and La Trobe University through the ARC Centre of Excellence in Plant Energy Biology; with the ANU and CSIRO through the Australian Plant Phenomics Facility; and previously with the Universities of Melbourne and Queensland through the recent ARC Centre of Excellence in Plant Cell Walls and Australian Centre for Plant Functional Genomics.

The University is one of six core research partners and almost 60 total partners in the Fight Food Waste CRC; and which together with the University of Adelaide-led Agricultural Product Development Research Consortium, which brings together 18 partners, including nine national and international academic institutions, are developing high-value nutraceutical and value-added products from agricultural and food waste. We have also extended our research partnership with SARDI to attract greater investment and deliver greater economic benefits to the primary industries sector. We utilise each other's strengths on collaborative research to expand and embrace expertise in areas such as engineering, mathematics, computer science, big data, and machine learning, for the application of new technologies.

In addition, the University also enjoys close research collaborations with Shanghai Jiao Tong University through the Australia-China Joint Research Centre of Grains for Health, which seeks to develop healthy grains to reduce the risk of diabetes and other diseases, and the Joint laboratory for Plant Science and Breeding, which investigates rice and barley reproduction. A China-Australia Joint laboratory in Soil Ecological Health and Remediation has also been established between the University of Adelaide and the Shandong Academy of Sciences.

Future collaborative opportunities

History tells us that significant leaps in productivity require coordinated investment delivered through mission-like programs focussed on improving productivity and achieving resilience in agricultural communities. This investment needs to be structured to drive the convergence of diverse technologies (synthetic biology, big data, satellite imagery), together with social and geographic capabilities. Moreover, to maximise benefits to regional economies, innovation precincts need to be developed with the ability to upskill regional workforces in domains such as machine learning, artificial intelligence and development of new crop types.

The University of Adelaide, together with Australian National University and the University of Western Australia, believes that in the context of ever-changing markets and climate, a *National Mission for Future Crop and Community Resilience*, to transform Australian agricultural resilience and thus productivity and rural communities, is essential to meeting the challenges of productivity and growth. Over the coming months the three universities and other national research partners intend to develop collaboratively a *National Mission* proposal that leverages industry support to enable transformative economic benefits to be achieved across our entire crop-based agriculture sector through key research breakthroughs. This submission will align with the decadal plan for Australian Agricultural Sciences (2017-2026) produced by the

Australian Academy of Science, the National Agricultural Workforce Strategy, and the Industry Growth Centre (Food Innovation Australia Limited) Sector Competitiveness Plan.

We note and welcome the recently announced *ARC Centre of Excellence for Plant Success in Nature and Agriculture* – an investment that contributes to the foundation of a National Mission. While agriculture is responsible for 20% of global GDP, only 3% of research and development investment is spent on preparing it for the future. **This level of research investment will not be sufficient to meet future food demand and for Australian agriculture to become a $100 billion industry by 2030**. Reaching this goal will require large-scale, multi-disciplinary investment in industry-aligned research and innovation.

Advances in synthetic biology (gene editing and transformation) coupled to changes in the regulatory environment controlling genetically modified crops mean that we will soon have an opportunity to create climate-resilient 'smart crops' – crops capable of growing during periods of drought and extreme temperatures, and which can better tolerate adverse soils. Future crops will also enable farmers to alter the types of products their crops produce during cultivation to account for different weather conditions. This will help to ensure agricultural production against adverse seasonal conditions, and to improve productivity through an expansion (or, at least, mitigating against a reduction) of agricultural land that is productive. These synthetic biology advances, together with improved climate forecasting, knowledge of environmental variability across farming landscapes, and autonomous farm vehicles and harvesting systems capable of precision planting, tilling and harvesting, will enable farmers to optimise production at a micro-climate level, affording greater control in both good and bad years.

For many regional areas, agriculture underpins the local economy, providing employment on farms and in related industries/sectors. Because of this, reduced crop production (e.g. due to droughts, floods, saline soils, heat waves, frosts) can have a profound effect on regional jobs. A *National Mission for Future Crop and Community Resilience* will necessarily have spill-over benefits to rural communities. It is essential that those communities be central to the mission – to drive adoption and uptake of new technologies and to ensure that the social changes and adaptations occur smoothly and effectively. This proposed Mission needs to be structured to drive the convergence of diverse technologies (synthetic biology, big data, satellite imagery, etc.), together with socio-economic, and more explicitly social capabilities in order to drive adoption and ensure that resilience in communities is achieved. Moreover, to maximise benefits to regional economies, innovation precincts need to be developed with the ability to upskill regional workforces in areas such as machine learning, artificial intelligence and development of new crop types. Importantly, the advent of 'smart crops' will provide opportunities for regionally-based agricultural scientists and consultants working with farmers to optimise crop selection to suit upcoming seasons, develop new management practices, and ensure productivity is maximized across heterogeneous landscapes.

Between the University of Adelaide, the Australian National University and the University of Western Australia, we believe we have formed a core national capability to drive a *National Mission for Future Crop and Community Resilience* outlined above. Of course, a National Mission like this will need to bring together other capabilities, institutions and sectors from across the nation. The current team has been built upon collective strategic intent, developed from shared experiences through crop-science focused ARC Centres of Excellence, combined with their wider capabilities in environmental/computer/social sciences, engineering, and policy development. It also brings together a blend of geographies, communities and climates with the key national institutions that can both generate the appropriate technologies and training and produce the cohorts of graduates with skills to apply to the transformed Australian agricultural sector of the late 2020s and into the 2030s.

Investment in a *National Mission for Future Crop and Community Resilience* – when leveraged by non-government sources including translational partnering with industry – would enable transformative outcomes to be achieved across our entire crop-based agriculture sector, allowing the $100 billion agricultural sector target to become a reality by 2030.