Regarding: Inquiry into growing Australian agriculture to $100 billion by 2030

Terms of reference*: The Committee will inquire into and report on, the opportunities and impediments to the primary production sectors realising their ambition to achieve a combined $100 billion value of production by 2030.*

This submission to the inquiry into growing Australian agriculture to $100 billion by 2030 identifies (1) a key impediment which relates to the separation of both water and nutrients from waste water resources; and (2) an example of how this impediment could be turned into an opportunity.

1. **Limitations in the current technologies available in Australia for separating water and nutrient resources from saline and contaminated water sources are an impediment to growing primary production**

Access to an economical and sustainable supply of water, and key nutrients such as nitrogen, phosphorus and potassium, is a limitation to increasing primary productivity in Australia [1].

Australia has sufficient water and nutrient resources to support the proposed growth in agriculture but it is not in an accessible form. For example, the abundant water and nutrient resources within sea water, flood and urban waste water are currently inaccessible. Areas in Australia that flood on an annual basis, such as the northern monsoonal regions, regularly receive sufficient water to sustain growth in the agricultural sector but flood water composition is incompatible with primary production systems and there are technical challenges to capturing and processing flood water. Excess nutrients in oceans, flood waters, and urban and agricultural waste water are a potential source of valuable resources that are not currently being utilised, and the nutrients lost within waste water resources are currently a problematic cause of eutrophication [2].

Climate forecasts indicate that Australia is likely to trend towards alternating between more frequent and severe drought and flood scenarios [3,4,5]. Therefore, the quantity of fresh water available to agriculture will decrease and the quantity of contaminated flood water in Australia will increase. To support growth in agriculture we need to invest in systems for separating water and nutrients from saline, flood, urban waste and contaminated water sources.

2. **Australia has a unique opportunity to advance the development of the membrane separation technology needed to mine our water and nutrients from sources of saline, flood and urban waste water**

The membrane separation industry is growing in the order of 10% per annum, and it is estimated to reach a value in the order of $USD 40 billion this year [6].

One of the technologies at the forefront of membrane separation includes water filtration technology where water channel proteins, called ‘aquaporins’, are embedded in fibres inside filtration equipment [8,9]. These types of systems are sufficiently advanced to enable the separation of pure water from waste water sources with both a higher exclusion of undesirable elements and a minimal energy input cost when compared to the traditional reverse osmosis purification of waste or saline water [10,11].

The focus of ‘aquaporin’ based filters has been directed at filtering waste and saline water to create pure water. These technologies have been created overseas. Key research required to develop these filters was funded by the National Aeronautics and Space Administration (NASA), and the resulting filters are used by astronauts to recycle 93% of their waste water [12]. It would be prudent for Australia to invest in advancing this type of technology considering the water security challenges we face.

The concept of ‘aquaporin’ based filter technology can also be re-purposed for mining nutrients and elements such as lithium from sea water and waste water. There has been minimal development in this area of research globally and this presents an opportunity for Australia to lead in advancing filtration technology for mining valuable elements from saline and waste water sources.

Australia has a strategic advantage in relation to developing ‘aquaporin’ based filters for element mining because the Australian Research Council (ARC) has invested in fundamental research involving extensive testing of plant aquaporin permeability. The filtration technologies developed overseas utilise aquaporin proteins from bacteria. Bacteria generally contain one or two types of aquaporins, whereas many plant species contain hundreds of different types of aquaporins with different specificity in their permeability to different substrates.

As a consequence of ARC investment in research involving testing plant aquaporin function we have a wealth of intellectual property information related to aquaporins which can support both the improvement of crop plant performance, and the advancement of water filtration technologies. This intellectual property gives us a unique opportunity to translate the fundamental information we have gained about plant aquaporin function into advanced technologies for mining clean water and valuable elements from saline, flood, urban waste and contaminated sources of water.

With the above proposed type of technological advance, sea water and waste water could be mined to generate new supplies of clean water and nutrients for feeding into protected agricultural systems, such as vertical farms and intensive urban food crop production systems, enabling significant growth in agricultural production.

References:

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