piccc
Primary Industries Climate Challenges Centre

The 2014 Melbourne Statement on Sustainable Intensification of Agriculture

Context

By 2030 the global population – currently growing at around 140 people per minute - is predicted to reach 8 billion[1], with an extra 2 billion people requiring reliable access to a sufficient quantity of affordable, nutritious food. The world's middle class is also predicted to rise from ~2.5 billion to 4.9 billion, over the same period[2]. The need to feed an extra 2 billion people, coupled with the increased demand for higher quality food from the rising middle class presents a range of challenges for humankind. Firstly, it is the humanitarian challenge to provide nutritional security for the resource-poor, particularly in developing countries. Secondly, the rising middle class presents a major opportunity for Australian agriculture to meet the rising demand for food in higher value markets. More people and more food required, but this extra food will have to be produced from less land, while reducing degradation[3], with less water, less energy-rich inputs, less greenhouse gas emissions and in a changing climate. Some have called this unprecedented confluence of pressures the 'perfect storm' of food security[4].

'Sustainable intensification' [5] is emerging as the new paradigm for agriculture to increase production on the existing land area, while also reducing the environmental footprint of food production[6]. However, translating the theory of sustainable intensification into increased Australian farm productivity - and simultaneously, increased ecosystem sustainability - requires new and innovative research.

Key Issues

Research over the past 60 years has provided the agronomy, husbandry, genetics and nutrition required for farmers to substantially increase production. However, much of the larger gains have been captured, while feed, fertiliser and water inputs have reached diminishing returns and new innovations are no longer delivering double-digit returns. Competition for water is increasing, current nutrient inputs are resulting in unacceptable offsite impacts; more inputs alone will no longer result in improved efficiency or sustainability.

1) Sustainable Intensification – the dual imperatives

Sustainable Intensification could be viewed as an enigma, as most agricultural intensification in the past has been accompanied by increasing impact on the natural resource base. As the world population expands, productive agricultural land per person is declining and current intensive practices cannot meet the dual imperatives of increased productivity AND increased sustainability. Failure to address the increased production required in conjunction with enhanced ecosystem management would only exacerbate the food security challenge for coming generations. There is no alternative other than to sustainably intensify agricultural production to meet these dual imperatives.

Sustainable intensification is urgently required in developing countries where a growing portion of world's population by 2050 will not have reliable access to a sufficient quantity of affordable, nutritious

[1] United Nations, Department of Economic and Social Affairs, Population Division (2013). Demographic Components of Future Population Growth, Technical Paper No. 2013/3. www.un.org/en/development/desa/population/publications/pdf/technical/TP2013-3.pdf
[2] Kharas H. (2010) The emerging middle class in developing countries. OECD Development Centre, Working Paper No. 285. http://www.oecd.org/dev/44457738.pdf
[3] The Montpellier Panel, December (2014) No ordinary matter: conserving, restoring and enhancing Africa's soils. http://ag4impact.org/wp-content/uploads/2014/12/MP_0106_Soil_Report_LR.pdf
[4] Buttriss, J. L. (2011). Feeding the planet: an unprecedented confluence of pressures anticipated. *Nutrition Bulletin,* **36**(2), 235-241. doi: 10.1111/j.1467-3010.2011.01894.x
[5] Pretty, J.N. (1997). The sustainable intensification of agriculture. *Natural Resources Forum,* **21**(4), 247-256. doi: 10.1111/j.1477-8947.1997.tb00699.x
[6] Nwanze K.F. (2012) Statement by the president of IFAD at the food security 2012 conference. Food Security 2012 - Sustainable intensification: miracle or mirage? http://www.chathamhouse.org/Foodsecurity2012

food and will need to produce their own food locally to sustain themselves nutritionally and economically.

However, in emerging and industrialised countries the world's rapidly rising middle class (4.9B by 2030) will be expecting higher quality and more nutritious food, but are also increasingly demanding animal-based protein in their diet. This group represents a significant opportunity for farmers in SE Australia, as the demand for higher quality, safe and nutritious foods will exceed supply at current rates of production.

2) Sustainable Intensification – the target

Sustainably increasing agricultural production in south eastern Australia faces a number of challenges:

- Urban expansion and rural lifestyle properties are rapidly taking over agricultural land;
- Significant areas of farmland face some form of degradation, mainly from erosion, soil acidity and soil salinity;
- Short term climate variability – with more frequent and greater extremes - and longer-term climate change both pose a challenge and risk for intensification and will increase competition for land in more reliable rainfall regions.
- The gap between potential and actual production is significant across a large proportion of farms, which provides both a challenge and an opportunity.

What would 'sustainably intensified' farms look like in 2050?

To address these issues, the University of Melbourne and the Victorian Department of Economic Development, through their Primary Industries Climate Challenges Centre (PICCC), hosted a strategic science 'think tank', focused on the '*Sustainable Intensification of Agriculture and what it means for South-Eastern Australia?*'

The challenge presented to the scientists at the Think Tank with was to address the question:

It is now 2050 and we are looking back at the past 35 years and identifying the key innovations, research, policies and practices, adopted by industry, that allowed us to increase agricultural productivity, while not increasing our impact on the environment or degrading the natural resource base - In other words, we have achieved Sustainable Intensification.

Speakers at the 'think tank' presented their visions for 'sustainably intensified' farms in 2050 and in so doing, identified the priorities for investment in the R,D and E necessary to develop the technologies, practices and policy settings necessary for successful sustainable intensification.

The Way Forward - Actions required

The common themes that emerged across the grains, dairy, horticulture, meat and wool industries provide a strategic direction for future R,D&E. These themes included:

- **Input/output efficiency** will need to improve on-farm and through the supply chain, particularly water and nutrient use. This includes greater adoption of current technology, to bring up the average closer to the potential, but a priority will be new innovative research to either improve input efficiency or break the bounds of the current diminishing returns response surface for water and nitrogen, in particular.
- **Climate Ready Farming and improved Risk Management:** Farms will need to become climate ready and incorporate greater risk management to address short-term variability, longer-term climate change and price volatility.
- **Precision electronic technologies** will both enable real-time and cost effective decision making, through linking these technologies with predictive models.
- **Big data:** Agriculture will also need a more coordinated framework for managing the masses of data that will be collected by electronic technologies along the supply chain, to enable the effective use of these data.

- **Credentials:** In order to target the high value markets, meet accreditation needs and achieve consistently higher prices, data will be required to quantify food quality, green and clean credentials and animal welfare standards. This can be delivered through innovative and broader use of data from precision electronic technologies.
- **Education and skills:** Farmers and agricultural advisers of the future will require a higher level of education and skills, plus more engagement in their supply chain. Education programs need to aim to equip the next generation of farmers and advisers with these skills.
- **Investment:** A key to delivering the sustainable intensification of agriculture will be to dramatically increase investment in all aspects of agriculture and to index this investment as a fixed proportion of agricultural GDP.

This Statement was developed from a Think Tank, hosted by the Primary Industries Climate Challenges Centre, held at the Melbourne Business School on the 30th September 2014. The event was attended by 94 delegates, including scientists, research managers, leading farmers, policy and extension officers and representatives from industry.

Appendix: Industry specific issues identified

Dairy

Contributors: *Joe Jacobs, Richard Eckard, Ben Hayes, Bill Wales, Peter Moate, Cameron Gourley*

- Water use efficiency:
  - 50% of farms use less than 500 L of water/L;
  - 50% less water for wash-down through recycling process;
  - 50% less water per t DM;
  - Precision irrigation.
- Nitrogen use efficiency:
  - Fertiliser N efficiency above 50% (improved techniques, precision timing and placement, and capturing N loss pathways);
  - Animal NUE improved by 50%.
- Animal genetics:
  - 50% greater feed conversion efficiency though 30% improvement in cow efficiency;
  - 50% less methane;
  - Improved heat tolerance, fertility and longevity.
- Plant genetics:
  - Improved heat tolerance, disease and pest resistance and nutritive characteristics.
- Nutrition:
  - Active management of ruminant microbial populations.
- Precision technologies:
  - Real time information to improve efficiency of resource use, reduced labour and time, precision feeding and milking.
- Climate ready production systems:
  - Securing forage supply, changing the seasonal emphasis of forage, heat stress management, climate ready farms.

Meat and Wool

Contributors: *Ralph Behrendt, Matthew Knight, Kevin Smith, Malcolm McCaskill, Martin Dunstan, Lyndon Kubeil, Darren Hickey, Jane Court, Robyn Warner, Richard Eckard, Andrew Kennedy, Margaret Raeside, Robyn Warner, Irene Sobotta, Paul Hemsworth, Narelle Fegan, Kari Gobius*

- Feedbase and nutrition:
  - Greater forage diversity and specialisation, new forages and dual-purpose crops.
- Genetics:
  - Improved reproduction and survival (3 lambs per 2 years);
  - Higher lean meat yield;
  - Genotype by environment management;
  - Improved feed efficiency.
- Reproduction and growth:
  - 150% weaning rates and reduced seasonality of breeding.
- Animal welfare and management:
  - Meeting consumer/market demands;
  - Automated and remote monitoring of animal health and welfare.
- Precision technologies:
  - Dynamic and real-time resource management and monitoring through precision electronic technologies.
- Climate ready production systems:
  - Improved seasonal pasture variability.
- Meat processing:
  - Food safety and welfare, and sustainable 'closed loop' processing;
  - Improved meat quality;
  - 100% utilized carcase;
  - Wireless quality, welfare and traceability monitoring.

Horticulture

Contributors: *Ian Goodwin, Sigfredo Fuentes, Rebecca Darbyshire*

- Genetics:
  - Consistent high yields of quality product, early bearing, high harvest index and radiation use efficiency;
  - Minimal temporal and spatial variation in yield, pest and disease management.
- Improved resource use efficiency (water, nutrients and chemicals)
  - Modernisation of regional water delivery and efficient fertigation.
- Climate ready production systems:
  - Managing extreme events;
  - Carbon neutral production
  - Wood for fuel or biochar, biosecurity.
- Precision technologies:
  - Reduced labour, mechanisation, robotics, organic sensors, wireless networks.

Grains

Contributors: *Roger Armstrong, Garry O'Leary, Chris Sounness, Sabine Tausz-Posch*

- Genetic X Environment X Management:
  - Closing the gap between current and potential yield.
- Genetics:
  - Water use and transpiration efficiency
  - Optimise plant N remobilisation.
- Nitrogen use efficiency:
  - New fertiliser formulations;
  - Increasing N fixed under elevated carbon dioxide.
- Precision technologies:
  - Use of robotics and mechanisation,
- Climate ready production systems:
  - Growth response to elevated carbon dioxide;
  - Improved resilience to climate extremes

Cross-Industry issues

Contributors: *Bill Malcolm, Andrew Western*

- Improved policy decision making, informed by economics and science.
- Investment in agriculture at 10% of agricultural GDP.
- Trade liberalization.
- Prices placed on externalities.
- Break the link between intensification and environmental impact.
- Whole systems understanding and thinking.
- Attracting young people to agriculture.
- Flexibility within farm and between farms.
- Managing the risk that creates returns.
- Water markets: Automation of water infrastructure; more cross sector trade.