Systemic adaptations to climate change in Western Australian mixed farm systems

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Abstract: Australia's primary industries have historically operated in a highly variable climate. This has posed significant challenges to production, requiring sound and responsive risk management practices. Climate change has, and will, introduce even greater challenges. This means that there is a clear need to continue to assess the opportunities for farmers to improve how they respond to climate variability and changes. We built representative mixed farm systems (using AusFarm) across climate gradients to investigate likely effect of climate change and variability and systemic adaptations to explore system's resilience, to enhance productivity under climate variability, and change by 2030. We used AusFarm to build mixed farm systems. Model inputs were derived by consulting with producers and models performance was validated against survey data.

For a climate gradient of 335-215 mm rainfall (Apr-Oct) in Western Australia, we evaluated long term average effectiveness of changes in planting date, fertilizer application rate, crop and stubble grazing, and stocking rates (SR) for 2002-2012 as baseline. To assess the impact of climate change, we used two high-emissions CMIP3 scenarios (A1FI and A2) with high and medium sensitivity and six global climate models projected climate for 2030. In 2030 and in a relatively medium rainfall region (MR) of the climate gradient, wheat, barley, canola production changed by +6%, +2%, and -2% on average while meat and wool production increased by 1% and 2%. In 2030, and in lower rainfall (LR) end of gradient, wheat, barley, canola, and lupine production changed by -8%, -2%, -11% and -16% while meat and wool production changed by -2% and -4%. In 2030, GHG emissions changed by -10% for LR and -5% for MR under current management.

In addition to systemic combination of options described above, we evaluated a range of climate adaptation packages, which were determined in collaboration with stakeholders. These adaptation packages designed specifically for each region to reduce negative impact and risk of climate change and benefit from likely opportunities. Alteration of the crop-livestock balance is an adaptation that can compensate negative impact of climate change by reduction in business risk. These were evaluated through a package with elements of optimizing area proportions of cropping and pasture either by changing the relative areas of existing crop & pasture sequences or the relative length of crop & pasture phases, optimizing stocking rate, and adjustments in livestock joining and sale dates. We designed low-variability to high-intensity mixed farming as adaptation packages optimised for different risk and return management approaches. Overall, financially optimal systemic adaptations were projected to offset negative impact of climate change on production and profitability of whole farm system in 2030 at majority of sites. This would require for practice and land use change to cope with changes in climate.

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