REPORT TO
THE DEPARTMENT OF JOBS, PRECINCTS AND REGIONS
11 MARCH 2019

SUPPORTING AGRICULTURE TO ADAPT TO CLIMATE CHANGE

STREAM 1: UNDERSTANDING CLIMATE CHANGE AND CURRENT APPROACHES

EXECUTIVE SUMMARY

ACIL ALLEN CONSULTING PTY LTD
ABN 68 102 652 148

LEVEL NINE
60 COLLINS STREET
MELBOURNE VIC 3000
AUSTRALIA
T+61 3 8650 6000
F+61 3 9654 6363

LEVEL ONE
50 PITT STREET
SYDNEY NSW 2000
AUSTRALIA
T+61 2 8272 5100
F+61 2 9247 2455

LEVEL FIFTEEN
127 CREEK STREET
BRISBANE QLD 4000
AUSTRALIA
T+61 7 3009 8700
F+61 7 3009 8799

LEVEL ONE
15 LONDON CIRCUIT
CANBERRA ACT 2600
AUSTRALIA
T+61 2 6103 8200
F+61 2 6103 8233

LEVEL TWELVE, BGC CENTRE
28 THE ESPLANADE
PERTH WA 6000
AUSTRALIA
T+61 8 9449 9600
F+61 8 9322 3955

167 FLINDERS STREET
ADELAIDE SA 5000
AUSTRALIA
T +61 8 8122 4965

ACILALLEN.COM.AU

EXECUTIVE SUMMARY

In April 2018, the Agriculture Ministers' Forum (AGMIN) agreed on the importance of ongoing cooperation between governments to support adaptation to climate change and in managing emissions in agriculture. Ministers agreed to develop proposed actions and a work program to inform the development of a coordinated national approach to adaptation to climate change and managing emissions in the agricultural sector.

Ministers requested the preparation of advice providing an overview of climate scenarios and potential impacts; a stocktake of the current work being undertaken by jurisdictions on adaptation and managing emissions; and the identification of opportunities and risks of climate change in agriculture. This work will provide input to officials in their preparation of advice to Ministers, proposing actions and a work program to support a coordinated national approach.

This paper is the first step in the process and provides:

- an overview of climate scenarios and potential impacts
- a stocktake of the current work being undertaken by jurisdictions on adaptation and managing emissions in agriculture
- the identification of risks and opportunities of climate change in agriculture.

Subsequent work will analyse the opportunities and risks of climate change for agricultural industries and propose options for actions which could be considered as part of a work program for a coordinated national approach to supporting the agricultural sector adapt to climate change.

The importance of agriculture

Agriculture continues to be a vital component of the social and economic structure of jurisdictions across Australia and is the major economic driver of regional and rural communities. Australia is a world-leading producer and exporter of agricultural commodities, with exports showing a continuing growth trend over the past five years. In 2016-17:[1]

- total production of agricultural products was valued at over $60 billion
- agricultural exports were valued at an estimated $50 billion
  - Australia was the second and fourth largest global exporter of beef and wheat, respectively, with these commodities also representing the eighth and ninth largest sources of export income across all of Australia's exports
- the agricultural sector employed approximately 251,000 people.

[1] 2016-17 is used as the time period for economic data as it was the most recent year with full national data across all jurisdictions at the time of preparation.

The agricultural sector's strong performance over the past decade has been driven by significant productivity gains and major increases in the value of agricultural products, especially in export markets. Strong export performance has had flow-on impacts in the domestic market. The outlook for the sector is positive and, based on the current growth trajectory, is forecast to be valued at $84 billion by 2030.[2] However, the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) considers the export market going forward will be characterised by increased competition and lower prices.[3] Furthermore, climate change has already impacted Australian agriculture productivity. In the short-term it is expected that increased export volumes will compensate, and that the total value of agricultural exports will remain largely unchanged.

Future climate changes are expected to significantly impact the sector, especially as productivity growth is also beginning to taper off. This is leading to a change in focus, away from continuing productivity and yield gains, to product value and opportunities for value-adding.

Climate change adaptation and managing greenhouse gas (GHG) emissions are key issues for agriculture to address. Adaptation will be critical to maintaining productivity and offsetting the impact of climate change. While the sector only contributes 13.2 per cent to total national emissions, this proportion will increase if other sectors decrease their emissions. Action will be required, especially given that some importers, such as the European Union, are increasingly focused on the emissions intensity of their imports.

The emissions associated with land use change for agricultural purposes, or on land owned by agricultural producers, are counted under the 'Land use, land use change and forestry' (LULUCF) category, not under 'agriculture' emissions. The LULUCF sector includes both sources of emissions and sinks that remove carbon dioxide (CO_2) from the atmosphere and sequester it as carbon in living biomass, debris and soils.

Climate change modelling and scenarios

Australia's future climate will be primarily determined by three factors: the emissions scenario that is being most closely tracked (the scenarios are described by Representative Concentration Pathways (RCPs)), the response of the climate system to that scenario, and natural variability. The Intergovernmental Panel on Climate Change (IPCC):

- has concluded that human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels
- is highly confident that global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate
- considers that for RCP8.5 (the scenario with the highest emissions trajectory), the likely range of temperature change is 2.6˚C - 4.8˚C, by the end of the 21st century.[4]

In 2015, drawing on the IPCC Reports, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BoM) developed detailed climate projections for Australia, as a whole and regionally, under three RCPs scenarios. Projections are provided for modelled climate variables, such as temperature, rainfall, wind, and derived variables, such as indices of climatic extremes, fire weather, soil moisture.

CSIRO and BoM's projections were developed for the whole of Australia and for Natural Resource Management (NRM) regions. Jurisdiction level projections were not presented. They are reflective of natural systems, and as such the approach does not readily align with agricultural production regions or reflect local-scale climate conditions that drive on-farm/regional production systems. A number of states have undertaken projections to fill these gaps but there is a lack of commonality in approaches and assumptions, making it difficult to compare like with like. There could be value in improving the ability to better forecast variability/extremes and decadal projections.

The modelling provides insights as to potential climatic conditions out to 2090. Beyond 2030 the scenario pathways diverge quite strongly, dependent on the emissions outcome that is achieved.

2 ACIL Allen Consulting 2019 (in press); *Agriculture – a $100 billion sector by 2030* Phase 2 Report; AgriFutures Australia
3 Based on presentations from the ABARES Outlook 2018 conference.
4 IPCC Climate Change 2014 Synthesis Report Summary for Policymakers https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_SPM.pdf

Given that the long-term climate signals, such as gradual rise in temperatures and an overall, but not consistent, drying effect, only manifest themselves slowly, short-term indictors are essential. Indicators relating to extreme weather events, such as time spent in drought and other short-term impacts, are critical. They represent the most obvious impact of climate change from an agricultural perspective. These extremes are particularly important as they provide early indicators as to the need to implement adaptation measures e.g. the impact of heat wave stresses on horticultural crops and dairy production. However, gradual changes such as less autumn-winter rainfall across southern Australia and uncertain rainfall effects in north west Australia are becoming more evident.

A critical gap in relation to the projections is the lack of a coordinated program (across all jurisdictions) to translate the projections into effective local-level adaptation tools, with direct on-farm application, and in the setting of enabling policies and investment strategies. A limited start has been made on this work by CSIRO and some NRM groups.

The majority of detailed research into climate change impacts on Australian agriculture (considered in this analysis) are focused on the period out to 2030, where more certainty exists. Long-term projections go to 2090 or beyond, and some mid-term work has been undertaken with a 2050 focus. Given the greater availability of information, the focus of the report has been on the short/mid-term period, out to 2030. This has been supplemented by 2050 and 2090 considerations as appropriate.

Impact of climate change on agriculture

The assessment of the impacts of climate change projections on Australian agricultural production considered a range of factors:

- the range of agricultural commodities produced, and the main commodities by value
- the mix of agricultural commodities in each jurisdiction, and their relative importance to that economy
- the drivers of production, productivity and profitability, and the range of risks to be managed
- the scale and diversity of the climatic regions in Australia
- the changes in climate already experienced, and the extent to which agriculture has already adapted
- the nature, extent and rate of change projected under the three RCP scenarios.

Nine commodities are assessed: the top commodities by value of production, plus some additions which make a major contributor to one of more jurisdictions. These are cattle, milk (dairy), wheat, sugar cane, cotton, potatoes, wine, mangoes and melons. Some of these have a strong affinity to similar commodities (i.e. wheat to coarse grains). Others have a particular susceptibility to climate change impacts given their specific growing requirements, such as cotton, given high water use; viticulture, given high sensitivity to changes in temperature and heatwave stress, etc.

While this coverage is not comprehensive, a review of the research into the impacts of climate change on the productivity and yields of these commodities provides insights as to how the overall agricultural sector may fare. There is strong research evidence that climate change has already impacted both productivity and yield on a range of commodities and will continue to do so out to 2030. Beyond 2030 there is less certainty but as a general observation the impacts will become more pronounced.

However, there are clear opportunities to stem this drop in productivity through adaptation measures. In the short-term (i.e. out to 2030), the impact from extreme weather events and fluctuations in climatic conditions such as severe/prolonged drought, rather than the underlying climate signal (i.e. increase in temperature and general drying effect), will generate the most impact for the majority of commodities.

There is a considerable amount of analytical work and research examining the impact of climate change on production. However, it tends to be fragmented, with many specific, and regionally focused, in-depth studies. While it may be possible to extrapolate some of these results at a commodity-wide level, given regional differences, and the lack of detailed climate projections at the local/regional level, results need to be treated with caution. There are also challenges in ensuring that research outcomes, in terms of both climate modelling and the impacts of climate change on productivity, are made available in a way that allows them to be applied in decision making at the on-farm level.

Work by ABARES and others indicates that the sector has been able to maintain productivity and yields over the last 25 years. However, 'business as usual' research and innovation (R&I) efforts are just managing to maintain existing levels of productivity, rather than enabling productivity growth.

There are also growing concerns that future productivity gains from R&I will not keep pace with the negative impacts of climate change.

Looking forward to 2030, the impact on most of the sectors examined is significant, even though there is scope to address any reductions in yield through farm management practices and adaptation. However, some sectors, particularly beef will face significant challenges, given the analysis points to a decline in productivity of up to 5 per cent by 2030. More drastic adaptation action will be required to maintain production. Beyond 2030, the impacts across most commodities are likely to be more severe with an acceleration in productivity losses being the norm for most commodities. Concerted adaptation action will be required to maintain both productivity and yield.

Economic impacts

The availability of substantial economic modelling results, such as computed partial and general equilibrium modelling, of climate change impacts across all agricultural commodities and regions is very limited. Economic modelling of climate change from an economy wide perspective is available. However, there is a significant gap in relation to work that is focused on the specifics of the agricultural sector, and that incorporates more sophisticated assumptions and regional changes highly relevant to key agricultural commodities.

Accordingly, a conservative and simplified approach has been adopted to provide some insights as to possible economic impacts and potential consequences of climate change for key commodities. The key assumption underlying the analysis is that the potential changes in productivity and yield indicated by the research, will directly and proportionately flow through to value. The assumption of direct causal relationships oversimplifies the assessment.

The focus on yield and productivity obscures other critical effects, such as impacts on quality, marketability and price; seasonal shifts in production, which potentially affecting market windows, competitive advantages and price; and changed distributions of pests and diseases, which will bring increased costs of management and challenges for export market access. Equally important, it also excludes the effects of drought and storms and other extreme weather events/shocks, which are increasingly important in terms of their economic impact on agriculture.

The analysis does not consider demand side effects, such as changing consumer preferences; nor does it address changes in global markets which may have a significant impact on value (both positive and negative) as future import/export opportunities play out. Furthermore, it does not take into account new and emerging technologies and practices that will support adaptation and emissions management in agriculture and offset the overall economic impacts.

TABLE ES 1 sets out the major value impacts, in real terms, for the three key commodities most impacted by climate change out to 2030. The loss in value is significant. Across all nine commodities the economic outcomes are quite different, even though all show some decline in value. In some cases the declines only become significant after 2030. The combination of potential production and yield declines, coupled with rising production costs, as inputs such as water become scarce and more expensive, results in positive and negative outcomes, in terms of both commodities and jurisdictions. Economic impacts are likely to become more marked beyond 2030.

TABLE ES 1 ECONOMIC IMPACT ON CATTLE, MILK AND WHEAT SECTORS

Agricultural commodity	2016/17 value	2029/30 value (real)
Cattle	$12.14 billion	$8.36 billion
Milk	$3.69 billion	$2.65 billion
Wheat	$7.37 billion	$5.28 billion

Note: Values are in real terms; the real figures are adjusted for inflation of 2.5% per year; based on the Reserve Bank of Australia's target; table only reflects yield declines (rather than changes in production costs or land use)

SOURCE: ACIL ALLEN CONSULTING

There are also possible significant economic implications associated with managing emissions from agriculture. Clearly there will be an interplay between adaptative measures to address productivity losses and the level of emissions, and one may well offset the other to some extent. However, looked

at in isolation, the impact on the value of the cattle sector could be nearly as significant as the impact due to declining productivity. The analysis is based on a simple set of assumptions and assumes no abatement actions to offset the declines in value.

As the largest single source of agricultural emissions, the impact from emissions management is likely to be most significant for the cattle sector. While there will be marked differences between commodities and jurisdictions, the analysis illustrates the challenge ahead. The prospect of this significant loss in value emphasises the importance of addressing both emissions mitigation and adaptation methods in tandem.

There are a range of other outcomes with economic implications (to be explored as part of subsequent work), which will flow from the impacts of climate change, including:

- Building resilience - agricultural viability is dependent on individual businesses' ability to manage the increased climatic variability through long-term preparedness planning and risk assessment.
- The value of carbon - abatement actions to manage emissions will, in effect, result in an implicit carbon price, enabling a range of 'carbon farming' initiatives.
- Rural adjustment - the current trend to larger farming enterprises is likely to continue, in part driven by climate change impacts. Coupled with climatic fluctuations and extreme weather events, adjustment will, in turn, link to a range of social impacts. These include regional community development and sustainability; residential mobility; financial wellbeing; employment; mental and physical health, etc.
- Asset valuations - climate change impacts will bring greater attention to the value of farm assets, and other adaptation initiatives. The scarcity of water, in particular, will become a key factor in valuation.

Government actions

Australian governments are implementing policies and programs to facilitate adaptation to the impacts of climate change and manage GHG emissions. There is a growing body of research detailing the impact of climate change on a range of agricultural commodities. Adaptation will be vital to maintaining both the productivity and economic value of the sector into the future.

Jurisdictions have responded to international agreements for action on climate change, such as the Paris Agreement[5], and developed legislative and policy responses through setting emissions reduction targets, and the development of adaptation strategies and plans. There is significant variation in the approach to adaptation planning across jurisdictions, which include commodity-based, state-wide and regionally specific action plans.

A consistent theme across a number of programs is the lack of coordination, particularly in terms of applied R&I to address climate change impacts on agriculture and, importantly, the promulgation of outcomes and lessons at an on-farm level. Policy settings are critical to support this. While there are a wide range of tools and climate projections available, application of these at the local level to assist with day-to-day farm management has been limited.

There are a number of models which could be readily adopted to enhance cross-jurisdictional collaboration and harmonise action. These will be considered through the Stream 2 and 3 work.

Next steps

Climate change presents both opportunities and risks to the agricultural sector. The anticipated productivity and yield losses for many agricultural commodities, in the short to medium-term, will focus attention on adaptation measures, to maintain value and profitability and build resilience. Government policy, consumer preferences and supply chain demands are placing increasing pressure on the agricultural sector to manage its emissions.

Stream 1 has served to identify the underlying issues that agriculture will face. Stream 2 will explore, in detail, the opportunities and risks that climate change presents to the sector. It will consider them within the broader context of the many factors influencing decision making by both government and industry.

[5] The Paris Agreement is an agreement within the UNFCCC, dealing with GHG mitigation, adaptation, and finance, signed in 2016