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Climate change adaptation to support agriculture in Queensland

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Climate change adaptation to support agriculture in Queensland

by

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For:

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1. Past climate variability and climate change

Queensland experiences a high degree of natural climate variability, from year to year, decade to decade, generation to generation and longer timescales. Some of this variability is driven by the El Nino-Southern Oscillation (ENSO) and the Interdecadal Pacific Oscillation.

In addition, we know that Queensland's climate is changing in response to greenhouse gas increases and other changes in atmospheric properties arising from human activities. Consequently, Queensland's climate can no longer be understood in terms of natural variability alone.

2. Future climate variability and change

A great deal is now known about future climate, largely from information obtained from sophisticated, though imperfect climate models. Climate model output provides information on future air and ocean temperature, rainfall, sea-level, and many, many other variables.

Expectations for Queensland's future climate can be found on, e.g., excellent Queensland government websites (e.g., the Queensland Climate Future Dashboard, and elsewhere), in Queensland's Agricultural Sector Adaptation Plan (2017), in many subregional brochures produced by UniSQ (multiple reports by Cobon et al. 2017), and elsewhere (e.g., https://www.agriculture.gov.au/agriculture-land/farm-food-drought/drought/future-drought-fund/climate-services; https://www.climatechangeinaustralia.gov.au/en/). While all valuable, some of this information needs updating to reflect subsequent advances in understanding. Nevertheless, some general expectations for Queensland's climate are given in the diagram below.

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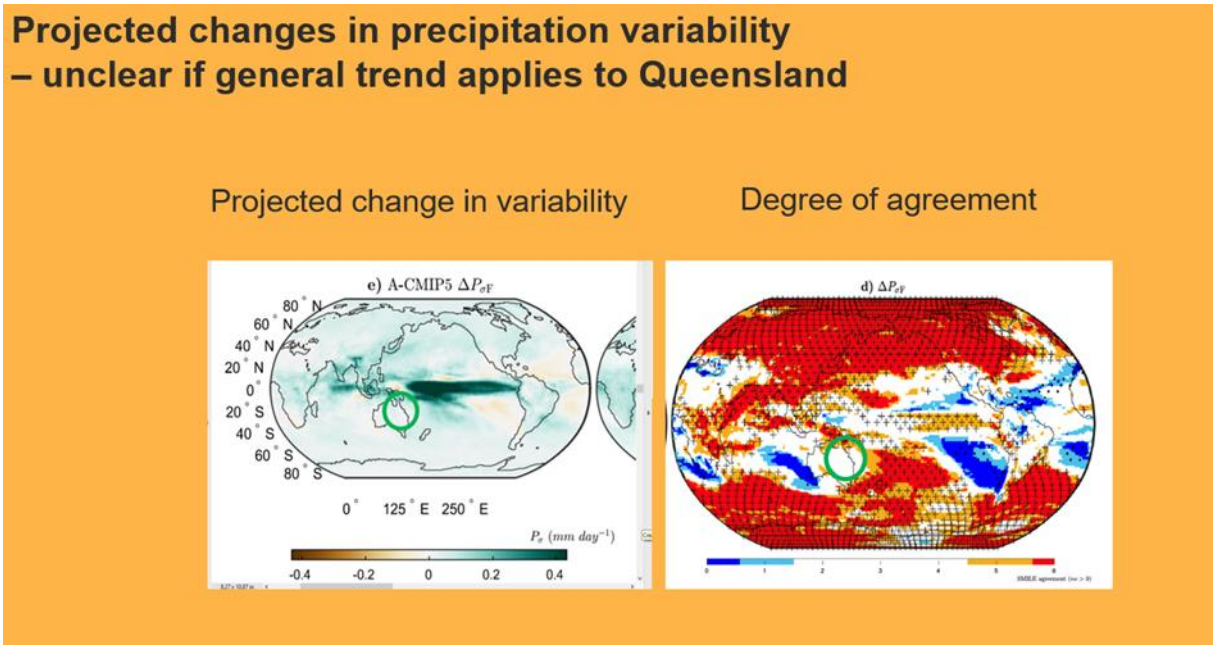
***Source**: https://www.qld.gov.au/__data/assets/pdf_file/0023/68126/queensland-climate-change-impact-summary.pdf. Additional information obtained from downscaled projections are provided by the excellent Queensland Future Climate Dashboard.*

There is high confidence in some projections, less confidence in others. This is indicated by the ticks I've added to the diagram above: The ticks which are not opaque indicate that climate scientists have high confidence in the projection. Climate scientists have less confidence in the projections with partially opaque ticks (i.e., for changes in seasonal rainfall tropical cyclones).

An additional important general result, applying over much of the globe, is that the global water cycle, including its variability, "is projected to further intensify" (IPCC 2022). While it is commonly believed that preciptation variability will increase in Queensland (e.g., in the Queensland Agricultural Sector Adaptation Plan, QASAP. 2018), it is not clear that this is in fact the case. This is illustrated in the diagram below. Further research is needed to clarify this important issue.



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Panel on left indicates general result that precipitation variability is expected to increase in many places. A measure of the confidence we have in this projection at different locations is given by the panel on the right. Confidence is higher at locations where there is colour and either crosses or dots. Most of Queensland has neither colour nor symbols, suggesting that variability in Queensland might be an exception to the general rule. ***Source:*** *Maher et al. 2020.*

Another key issue for Queensland is the extent to which anthropogenic climate change has already influenced Queensland rainfall. Similar issues have been investigated intensely in other parts of Australia through major state government-supported physical climate science initiatives like the Victorian Water and Climate Initiative (VicWaCI, 2017-2024) and its predecessor, the Victorian Climate Initiative (2013-2016). Other major projects that investigated climate variability and climate change in other states includes the $7.5m Southeast Australia Climate Initiative (2009-2012), and the Indian Ocean Climate Initiative in Western Australia. Unfortunately, none of these major, multi-million-dollar programs considered climate change or climate variability in Queensland.

The programs in other states made a great deal of progress in clarifying the character, cause and prospects for climate variability and climate change in those states. As one of many examples, Rauniyar and Power (2020), with the support of VicWaCI, concluded that approximately 80% of the drying in Victoria during the highly impactful "Millennium Drought" (1997-2009) was due to natural variability and only 20% was due to anthropogenic climate change. Prior to this study, people were concerned that all of the drying was been driven by anthropogenic climate change, as no estimate was available prior to this study. This has major ramifications for the way in which climate change is communicated.

SE Queensland also experienced strong drying during the Millennium Drought. However, the extent to which anthropogenic climate change contributed to the multiyear south-east Queensland Drought is not known. Again, further research on a critical issue is required.

Queensland has not had a major program dedicated to clarifying issues related to the physical changes associated with climate change like the VicWaCI or WA's Indian Ocean Climate Initiative. Queensland is consequently lagging other states in its understanding of its own past and future climate change.

In Queensland the major investment in physical climate science has been for generating and disseminating downscaled projections for the state. This is very valuable work. However, it is insufficient. Building confidence in the use of projections can be more effectively facilitated if people know the stories behind the numbers. For example, why is precipitation expected to decline in SE Australia? To what extent has human-forced climate change already affected Queensland's climate? These stories are often lacking in Queensland because there is no Queensland-focussed climate science initiative to help develop them. And as noted above, key issues are unresolved.

Finally, projections available from the Queensland government are very valuable. However, other sources of information on future Queensland climate are available and more will become available over coming years. It would be ideal if all the major credible sources – not just the downscaled projections produced by the Queensland government - were also examined, assessed, and synthesized. This will ensure that Queenslanders are given the best available information on climate change, not just a subset of it.

3. Climate change and agriculture – impacts and adaptation

Information on the impacts of climate change and strategies to adapt to climate change and climate variability are available through, e.g., the IPCC report (IPCC 2022; Chapter 11: Australasia), QASAP (2018), and in the subregional brochures produced by UniSQ (multiple reports by Cobon et al. 2017). Again, while all valuable, some of this information needs updating to reflect more recent advances in understanding.

Other sources of information on impacts include Hughes and Gooday (ABARES), and Howlett and Henry (Aust. Academy of Sci.). There are also relevant research project reports and many relevant recent research papers that could be assessed and synthesized for broader consumption. However, the overall effort to improve understanding of impacts and adaptation strategies for Queensland Agriculture seems ad hoc, incoherent, and uncoordinated.

The Northern Australian Climate Program provides a valuable example of a RDE program, with strong emphasis on both adoption and measuring the impact of the interventions. One important feature of this program is the group of "Climate Mates" (Lavender et al. 2022). Climate Mates are champions in the use of climate and weather information. They are intermediaries who are climate-trained local farmers, advisors or consultants who live, work and are trusted in the community. They ascertain farmer needs for tailored products, and farmer views on prototypes, and have ready access to weather and climate experts at the Bureau of Meteorology and UniSQ. The Climate Mates provide a very effective link between producers and applied researchers. This helps the researchers have a clear understanding of what the producers need. This enabled the development of new tailored forecast products that the producers now use in their decision making.

Information to assist adaptation is provided in the Drought Resilience Self-Assessment Tool (DR.SAT). This is a free tool produced with the support of the federal DAFF. It "enables farmers to assess their resilience against climate change including drought and other climate risks. Resilience assessments include financial, personal and social, and environmental indicators. Based on farmers' individual assessments, the tool provides tailored options and resources to support farmers to build resilience". "The assessment is based on farmer-supplied information. Farmers have complete control over their information to maintain their privacy. The tool also contains regularly updated satellite imagery, remote sensed data, climate projections that inform resilience assessments and supports decision making on physical climate change risks". While there is a lot of very relevant information from multiple sources, it is complex and not yet widely used. DR.SAT might, consequently, be best suited for intermediaries like suitably trained extension officers, who can assist farmers in using DR.SAT or drawing information from it.

Climate Services for Agriculture (CSA) provides additional information on climate change of relevance to Queensland farmers. *This "online platform gives Australian farmers and communities climate information for their local area to help them better prepare for climate risks". "CSA provides users with historical data (1961-current), seasonal forecasts (1-3 months) and future climate projections (2030, 2050, 2070). It also includes additional climate insights for business planning, like:*

- *specific insights for individual commodities*
- *customisable rainfall and temperature thresholds*
- *a temperature humidity index for beef, dairy and sheep*
- *general climate trends".*

4. Barriers to adaptation and how to overcome them

While progress around the world on adaptation more broadly (i.e., not just in agriculture) is progressing, efforts to date are typically inadequate and the rate at which adaptation is advancing is insufficient, as risks associated with climate change are growing (IPCC 2022). Also concerning is the fact that implementation of climate adaptation plans is very limited, and there is negligible evidence that the strategies implemented actually reduced climate risks (IPCC 2022).

It seems that many people in the agriculture sector in Queensland believe that managing climate variability is sufficient to maintain their resilience, and most emphasis to date in Queensland has been on managing climate variability. While managing climate variability can help to address climate change in

some contexts, in many contexts managing climate variability alone is insufficient. For example, the long-term trend to higher air temperatures during cooler months might make mango production in some areas unsustainable. This risk might not be recognised if attention is restricted to variability alone. Furthermore, there is a lot of emphasis given to what we have seen in the past and not enough emphasis is given to projections, and the possibility that the future will contain things we have not witnessed before (Power and Delage, 2019).

Others may wish to improve their adaptation to climate change over and above adapting to climate variability, but are unsure how to accomplish this because practical and proven strategies might not be available or readily accessible. Some promising early approaches to help overcome this were attempted.

Another impediment to progress is that adaptation can sometimes get lost in the emphasis given to emissions reduction. Emissions reduction is critical and deserves to be the highest priority. However, both adaptation and mitigation need to be pursued simultaneously where possible (IPCC 2022).

Further information on barriers to adaptation and how to overcome them are described in, e.g., the IPCC report (IPCC 2022; Chapter 11: *Australasia*), QASAP (2018), and in the subregional brochures produced by UniSQ (various reports by Cobon et al. 2017).

5. What is needed to help QLD farmers strengthen their ability to adapt to climate change?

In my opinion, the following would assist:

i. First and foremost, **recognise that implementing widespread, practical, on the ground climate change adaptation among Queensland farmers** – over and above managing variability - **is a massive challenge.**

ii. **Build on and strengthen what is already there.** For example, lobby the federal government to expand the Future Drought Fund to include building resilience to climate-related hazards beyond drought.

iii. **Greatly expand adaptation planning and its adoption**
   a. Aim for practical climate adaptation plans for all significant agricultural subsectors in Queensland – cattle, sugar, cropping, aquaculture, fisheries, horticulture, …
   b. Increase support to assist councils in regions where agriculture is a mainstay to the local economy, to develop practical climate adaptation plans and help them implement the plans
   c. Consider threats to long-term viability, profitability and sustainability, and emerging opportunities in plans
   d. Ensure all new state government programs spell out clear, feasible paths to impact among Queensland farmers
   e. Encourage holistic planning to also consider, e.g., biodiversity, human welfare, greenhouse gas emissions reduction, including the opportunities these things present
   f. Ensure adoption is strongly supported
   g. Incorporate adaptation planning into broader business risk management
   h. Encourage the federal government to increase the scope of the Future Drought Fund to include other hazards that are exacerbated by climate change.

iv. **Increase coordination of climate change adaptation-related work in QLD**

a. Update the QASAP (2018) strategy co-developed by Ag industry including farmers, state and local govts, and relevant experts in state govt and universities, (e.g., climate scientists, social scientists, economists), first nations people, environmental managers
b. Update the QASAP (2018) stocktake of who's doing what, gaps, funds to fill gaps and a coherent and comprehensive applied research strategy/strategies
c. Prioritize risks
d. Help make QLD a world leader in simultaneous adaptation to both climate variability and climate change.

v. **More targeted, coordinated applied research to support adaptation**
   a. Expanded research to obtain greater clarity on future physical hazards, risks, opportunities, impacts, practical adaptation strategies; to reduce risk of maladaptation
   b. Greater emphasis on co-development of practical, specific, workable, on-the-ground action with clear and feasible paths to impact, not just research with outputs that sit on shelves
   c. More state govt support for Australian Research Council linkage grants on Queensland-led climate change adaptation with practical outcomes.

vi. **Create a major new physical climate science initiative for Queensland like VicWaCI to, e.g.,**
   a. Improve understanding of the character, cause and predictability of observed multidecadal climate changes in Queensland
   b. Clarify what will happen to climate variability in Queensland over coming decades
   c. Develop world-class projections information using information from multiple projection systems.

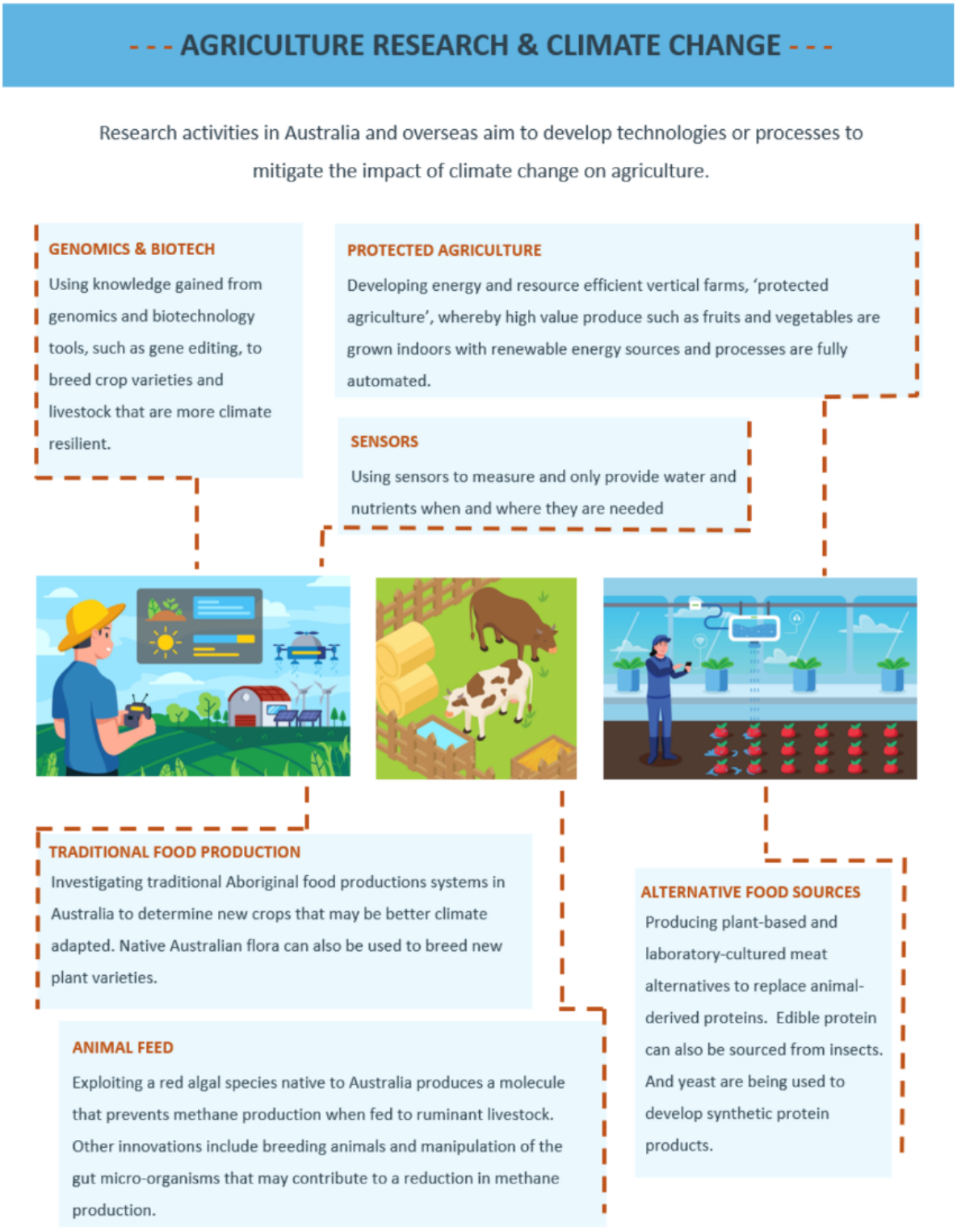
vii. **Strengthen and expand Queensland's Drought and Climate Adaptation Program**

The Drought and Climate Adaptation Program (DCAP) is a successful program that is *helping "producers better manage drought and climate impacts". "The best climate scientists, government and non-government agencies, producers and industry leaders are working together on a number of cutting-edge research projects and partnerships"*. One limitation of DCAP is that it largely consists of projects that help producers manage variability, with much less attention given to long-term changes.

I therefore recommend that DCAP is markedly strengthened to build on its success in climate variability management to address critical issues linked to long term change. An expanded and stronger program could increase clarity on crucial issues including:

a. What will the impacts of future climate change and variability be on Queensland agriculture?
b. Which elements of Queensland's agriculture are most vulnerable to climate change?
c. What specific, practical management options and tools are needed to better manage future climate change?
d. What risks does Queensland Agriculture face from climate change?
e. What is the relevant importance of these risks?
f. Which aspects, if any, of Queensland agriculture are unsustainable in the face of climate change?
g. What opportunities does climate change bring to Queensland e.g., growing a crop in a region where it might not have grown previously

h. Where and when do threats and opportunities lie and where and when might transformative climate change adaptation be required?



Some additional areas of research to support adaptation. Source: Howlett and Henry (Aust. Acad. Sci.)

viii. **Training, education, extension**

Support training at grass roots, with aim to develop simple, practical adaptation plans, options and tools, and help people implement them. Some of the approaches used in an early project, are worth considering

a. Support courses at high schools and tertiary institutions on adaptation
b. More short courses in practical adaptation
c. Provide climate training for e.g., extension officers in the public and private sectors
d. Ensure that there are mandatory standards in the understanding of climate science and its application among extension officers through, e.g., micro-credentialling
e. The state government could support the development of micro-credentialling courses at training institutions in Queensland
f. Consider increasing the number of extension officers in the public sector if the private sector is unable to meet a major need for the foreseeable future
g. Develop Climate Mates in other Agricultural industries to strengthen applied RDE and adoption, including the development of useful and user-friendly tools
h. Update plain language reviews and syntheses for industry.

ix. **Share lessons, information, know how**

a. Develop site where people and organisations can briefly describe their adaptation work, to help share lessons, monitor progress, and help identify gaps
b. Record practice change and whether it helped or not in subsequent years
c. Encourage people to enter data.

x. **(Left field idea): Show case region/s?**

a. Pick a region or two in Queensland as showcases for helping producers, communities, businesses, local govt manage climate change and climate variability and climate change.

xi. **Ensure Queensland's current weather and climate observing system meets current and future needs**

Background:

- Weather and climate stations are used to test and improve models needed for climate adaptation, and to downscale and translate information from models, so the information can be used more effectively at a local level.
- The distribution of the stations across Queensland is uneven.

Recommendations:

a. Assess the extent to which the current array meets current and future needs.
b. If it is found to be inadequate, then I recommend that the state government works with relevant federal agencies (e.g., the Bureau of Meteorology) to fill the gaps.

xii. **Insurance to help manage climate variability and climate change.**

As noted by Russell Mehmet from Willis Tower Watson (who works closely with Professor Shahbaz Mushtaq and Dr Jarrod Kath in the Centre for Applied Climate Sciences at UniSQ), there is potential for parametric-type insurance or mutuals (e.g., if rainfall exceeds or drops below a specific value at a specified location) to help Queensland farmers manage climate risk. And, as Professor Mushtaq points out, *"it is crucial to note that insurance mutuals have the potential to pool risk, make insurance products*

more affordable, and increase their adoption". However, as Mr Mehmet stated, this may need government support to establish and maintain the uptake of the insurance products produced.

Acknowledgements

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